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The Galaxy

This is the name given to that feature of the sky which under ordinary conditions the eye interprets as a band of slightly luminous, faintly visible matter, extending from the horizon, high overhead, and to the horizon again. If the atmosphere is hazy or if the sensitivity of the eye is lessened by artificial light this phenomenon is unnoticed. If, however, a favorable location, clear atmosphere, and good eyesight concur, the Galaxy affords a spectacle never to be forgotten and invests the night with a glory and a splendor indescribable. The eye sees it as a thing of transcendental beauty and is content.

But the mind in endeavoring to comprehend the Galaxy finds it necessary to coördinate into one system such varied classes of objects as billions of individual stars, one, at least, and possibly many others, accompanied by a retinue of planets; double and multiple stars forming smaller systems within the larger one; clusters of stars composed of hundreds or thousands and possibly in some cases hundreds of thousands of individual stars; and, finally, enormous quantities of tenuous gas, some of definite form and some confused and chaotic. The mind must also grapple with stupendous masses, with distances so great that the distance from the earth to the sun is totally inadequate as a unit of measurement, and with periods of time compared to which the average life of man is as the flash of a meteor across the sky. Having accomplished the titanic task of encompassing the Galaxy, the mind seeks rest.

But it cannot remain at peace. The struggle goes on. Other "Galaxies" present themselves for recognition and consideration. Possibly our Galaxy and other "Galaxies" are units in a larger system, and so on. Galaxies of galaxies. How exhilarating to the mind, how stimulating to the imagination!

The mind of man is moving outward seeking a goal which is not yet in sight. But the quest itself is highly compensative.

A Few Things About Copernicus

By ROSCOE LAMONT

In the *National Magazine* (New York) for November, 1852, there is an article entitled: "The Last Days of Copernicus. A True History." The place is a land far away near the Baltic Sea, and a man of kindly face and priestly dress is awake observing the heavens while the town of Frauenburg sleeps. The man is Copernicus. He is old and white haired. The manuscript of his book, on which he had spent the labor of

FIGURE 1.

a lifetime, is at the printer's. He has just received the last proof-sheets, but before sending them back he wishes to make one more observation to be sure that his system is right, so he spends the night in his observatory watching the stars. He directs his wooden triangle to the four cardinal points. There is no longer a doubt—it is right, and he utters a prayer of thanks. The proof-sheets are returned. Soon a horseman

gallops up to the door with a letter which says: "Your enemies are trying to break down the printing press and destroy your life work. Come and lay the storm, but come quickly or you will be too late." (The printing office was distant twenty-five Sheridan rides, with Copernicus five hundred miles away.) The horseman asks how soon he can set out. "I cannot go," said Copernicus, "the suffering workmen need my assistance." (Copernicus was a physician as well as an astronomer, and whatever may happen, at home he will stay to attend the poor.) The next day another letter arrives with bad news: "Three times the students of the University have tried to invade the printing office. The guards are sticking to their posts day and night, and the printers are setting type with one hand and holding a gun in the other." The next day's letter advised that a printer had been won over and had delivered the manuscript to the astronomer's enemies, and that it had been burned in the public square, but fortunately the type had all been set, and the presses were at work (the horseman must have been on Pegasus to have got there with the last proof-sheets, or maybe, after seeing those German students, they decided not to wait for them), "but a popular tumult may yet ruin all."[1]

Copernicus had his last days, which were not unduly troubled so far as known, and his book was not destroyed. He passed away on May 24, 1543, and although it is said he received a copy of his book the day he died, he was too far gone to read it, and it may have been well that he was. Supposing that he had opened it, he would have seen his name as the author of a work on which he had spent many years of hard labor, and after some description of it, the words "Igitur eme, lege, fruere"—"Therefore buy, read, enjoy"—and Copernicus might have

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[1] A good deal of history is about equal to this "true history." Copernicus was not a great observer like Tycho Brahe, but he had a wooden triangle of his own construction, which the writer of the article had heard of, which was about the extent of his knowledge of Copernicus. To prove that the earth goes round the sun by directing that triangle to the four cardinal points is amusing enough. Copernicus, in Book IV, Chapter XV, of his work, describes the instrument. Tycho Brahe, who later owned it, on the day he received it, July 23, 1584, wrote a poem of thirty-four lines on Copernicus, of which the following is a part, in translation. (See complete works of Tycho Brahe, edited by Dreyer. Vol. 6, page 266, Copenhagen, 1919.)

> He drew the sun from heaven's vault, its place assigned to stand,
> And then around the sky the earth revolved at his command.
> To him the hidden parts above 'twas granted to invade,
> No other mortal given this, ne'er since the world was made.
> The power of genius, what exceeds? In olden days the giants
> One mountain on another piled by every known appliance,
> Olympus, Pelion, Ossa massed, with Aetna's elevation,
> And countless others intermixed, a wild conglomeration.
> And yet they failed to reach the skies, though mighty their physique.
> The trouble with the giants was their minds were very weak.
> But he, the great illustrious man, with genius his ally,
> No strength of limb, with little sticks surpassed Olympus high.
> O monuments of such a man! Although of wood devised,
> The brightest gold would envy them, were gold of them apprised.

said: "Nobody will think that I wrote those words. Let the printer have his little joke; he probably needs the money." Turning over, he would see something headed "Ad lectorem de hypothesibus huius operis." "To the reader concerning the hypotheses of this work." He doesn't recall writing anything "To the reader," but his memory is not what it used to be. He'll look it through.

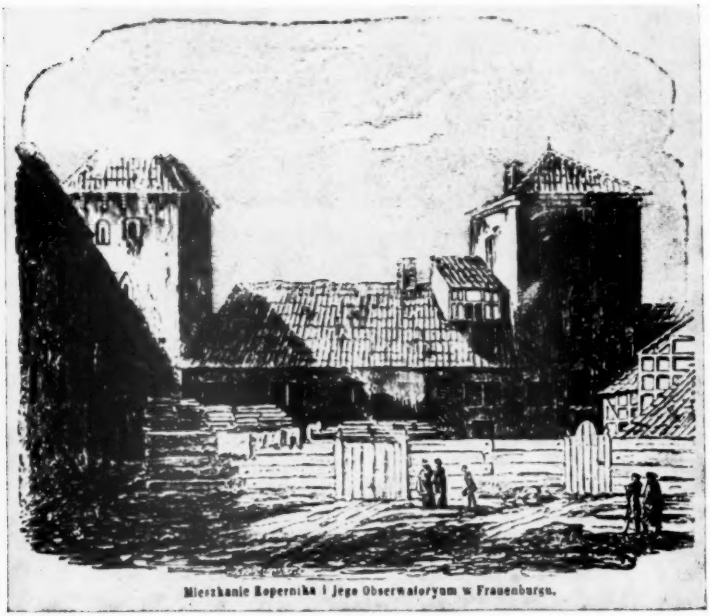

FIGURE 2.

RESIDENCE OF COPERNICUS AND HIS OBSERVATORY IN FRAUENBURG.
(From the Warsaw edition, 1854, of the works of Copernicus.)

The reader is told that doubtless some people will be offended by having the sun stand still in the middle of the universe and the earth moving, but if they consider the matter well they will find that the author of the work is not to be blamed; for the task of the astronomer is to gather up the history of the celestial motions by diligent observations, and then to set forth the causes or hypotheses about them so that these motions can be calculated on geometrical principles. Nor is it necessary that these hypotheses be true or even probable. It is sufficient if the calculations are in agreement with observations. "Let us, therefore, add these new hypotheses to the old ones which are not more probable, especially since these are admirable and easy, and carry with them a

prodigious store of learned observations. [There are only about twenty-seven observations recorded in the whole book.] Nor should any one expect anything certain from astronomy, because it can give nothing of the kind, and if any one takes for truth what has been devised for another end, he will leave this study more foolish than when he began it. Farewell."

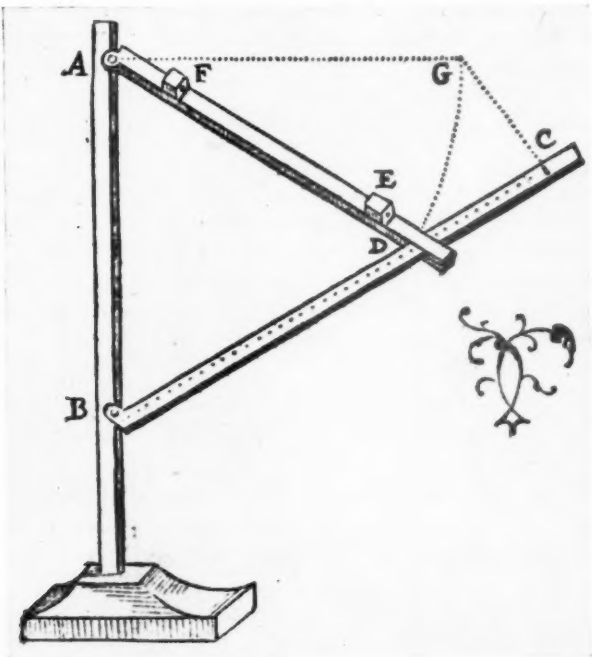

FIGURE 3.

COPERNICUS'S TRIANGLE, CALLED A PARALLACTIC INSTRUMENT.
(From the Amsterdam, 1617, edition of the works of Copernicus.)

Copernicus was very devout, and we are told that an undevout astronomer is mad. Had Copernicus perused the address to the reader, a devout astronomer would likely have been mad. And yet some historians of astronomy, as Delambre in his History of Modern Astronomy, have supposed this preface to have been written by Copernicus to ward off criticism—the reader being told that if he expects to learn anything true he will get fooled, and that it is not necessary that the hypotheses be even probable.

Gassendi wrote the first life of Copernicus of much importance that has been preserved. (Short lives were published by Melchior Adam

and Nicholas Mulerius in 1615 and 1617, respectively, but they contained hardly enough to pay for reading them.) Gassendi's life was published in 1654, and he says that the preface "To the reader concerning the hypotheses of this work" was written by Andreas Osiander, who supervised the printing. This was found out first by Kepler who announced it in 1609 in his book on the planet Mars, immediately after the title page. Others long before had claimed it was not written by Copernicus, Bruno having said in 1584, in his "Ash Wednesday Supper Talk," that "the epistle was tacked on by I know not what ignorant and presumptuous *asino*."

Copernicus dedicated his work to Pope Paul III, and to show the kind of language he wrote, at least when turned into English, a few passages will be given from the dedication, using the translation in the Harvard Classics (for the most part), Volume 39, page 55. These passages will show that to Copernicus the motion ascribed to the earth was not simply another hypothesis to be placed alongside the old one, but that in his opinion "the earth do move."[2]

> "I can easily conceive, most Holy Father, that as soon as some people learn that in this book which I have written concerning the revolutions of the heavenly bodies I ascribe certain motions to the Earth, they will cry out at once that I and my theory should be rejected . . . Accordingly, when I considered in my own mind how absurd a performance it must seem to those who know that the judgment of many centuries has approved the view that the Earth remains fixed as center in the midst of the heavens, if I should, on the contrary, assert that the Earth moves; I was for a long time at a loss to know whether I should publish the commentaries which I have written in proof of its motion, or whether it were not better to follow the example of the Pythagoreans and of some others, who were accustomed to transmit the secrets of philosophy not in writing but orally, and only to their relatives and friends, as the letter from Lysis to Hipparchus bears witness . . . Therefore, when I considered this carefully, the contempt, which I had to fear because of the novelty and apparent absurdity of my view, nearly induced me to abandon utterly the work I had begun.
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> "My friends, however, in spite of long delay and even resistance on my part, withheld me from this decision. First among these was Nicholaus Schonberg, Cardinal of Capua, distinguished in all branches of learning. Next to him comes my very dear friend, Tidemann Giese, Bishop of Culm, a most earnest student, as he is, of sacred and, indeed, of all good learning. The latter has often urged me, at times even spurring me on with reproaches, to publish and at last bring to the light the book which had lain in my study not nine years merely, but already going on four times nine . . .

[2] Draper, in his History of the Intellectual Development of Europe, had not heard of the preface "To the reader," but said it was thought by some that the dedication to the Pope was written by Osiander for Copernicus. That is as amusing as the "true history" in the *National Magazine*.

They said I should find that the more absurd most men now thought this theory of mine concerning the motion of the Earth, the more admiration and gratitude it would command after they saw in the publication of my commentaries the mist of absurdity cleared away by most transparent proofs. So, influenced by these advisers and this hope, I have at length allowed my friends to publish the work, as they had long besought me to do.

"But perhaps Your Holiness will not so much wonder that I have ventured to publish these studies of mine, after having taken such pains in elaborating them that I have not hesitated to commit to writing my views of the motion of the Earth, as you will be curious to hear how it occurred to me to venture, contrary to the accepted view of mathematicians, and well-nigh contrary to common sense, to form a conception of any terrestrial motion whatsoever . . .

"And so, after postulating movements, which, farther on in the book, I ascribe to the Earth, I have found by many and long observations that if the movements of the other planets are *compared with* the circular motion of the Earth, and are *computed* for the revolution of each star, not only do their phenomena follow logically therefrom, but the relative positions and magnitudes both of the stars and all their orbits, and of the heavens themselves, become so closely related that in none of its parts can anything be changed without causing confusion in the other parts and in the whole universe."[3]

It does not require one of the higher critics to conclude that the dedication and the preface "to the reader concerning the hypotheses of this work" are by different hands.

Tidemann Giese, Bishop of Culm, Copernicus's "very dear friend," who spurred him on with reproaches to publish the work, and to whom the manuscript was sent for publication, knew nothing of the singular preface until the book was printed. After seeing it he wrote a letter to Rheticus, a noted mathematician, who some years previously had visited Copernicus at Frauenburg. Rheticus, a young man of twenty-five, going from a hatching place of heresy, the University of Wittenberg, to far off Ermeland, one day, in 1539, "rode up to the gate of the cathedral-close and asked to see Canon Nicholas Copernicus." (Edinburgh Review, October, 1883, page 326). The stranger was invited in. He remained over two years, being charmed with his new Catholic friends, Copernicus and the Bishop of Culm. After studying the work of Copernicus he wrote an account of it called Narratio Prima (First Narrative—expecting to write a second one, which he never did), which was published in 1540 at Danzig, called Gedani, forty miles west of Frauenburg, as "by a certain young man studious in mathematics." (Re-

[3] In the last paragraph above the words in italics, "compared with" and "computed," are translated "assumed for" and "substituted" in "The Harvard Classics, The Five-Foot Shelf of Books." The sentence so translated has no meaning. Copernicus uses the Latin words "conferantur" and "supputentur."

published in 1541 under his own name.) Rheticus calls the great astronomer "D. Doctor, my Praeceptor."[4] He considers him the equal of Regiomontanus who lived in the fifteenth century, who had spoken the last word on astronomy, it was thought by some people, and who could make an almanac for thirty years in advance, the *Nautical Almanac* of the time. Indeed, the Frauenburg astronomer may be compared with the ancient Ptolemy. And Rheticus admires in Copernicus something which he has in common with Ptolemy—he is seeking to reform astronomy with divine aid. In more than one place he extols the Bishop, and not long after his arrival in Prussia, an encomium of which he wrote, "with the greatest civility, by the most Reverend D. Dominus Tidemann Giese, Bishop of Culm," he was invited, "together with my D. Praeceptor," to pay him a visit in Lobau, sixty miles south of Frauenburg, where he spent several weeks in study.

And so when Tidemann Giese, Bishop of Culm, saw, in the published work of Copernicus, the preface "To the reader concerning the hypotheses of this work," he wrote a letter to Rheticus. The letter has been preserved. It was first published in 1615 by Broscius, an astronomer at the University of Cracow. It is given in the Warsaw edition of the works of Copernicus of 1854, on page 640, and the letter in English is something like what follows:

To Joachim Rheticus:

On my return from the royal marriage in Cracow, I found at Lobau the two copies, sent by you, of the recently published book of our Copernicus, of whose passing away I did not learn until I reached Prussia. I grieve for the departed brother, illustrious man, who seems to come back to me in life, I could believe when reading the book; but at the very beginning I notice bad faith, and, as you truly say, the impiety of Petreius (the name of the printer), which fills me with fierce indignation rather than sadness. For who would not be furious at such a crime, committed under the protection of good faith? But yet it may be ascribed, not so much to this printer, depending on the industry of others, as to the envy of some one, who, grieving to descend from his former profession, if this book acquires fame, is perhaps abused by his simplicity to detract from the credibility of the work. But that he may not go unpunished, who has allowed himself to be corrupted by the fraud of another, I have written to the Senate at Nuremberg setting forth what seems to me necessary for protecting the credit of the author. I send the letter to you, with a copy of the same, that you may decide in the emergency in what way the matter should be taken up, for in managing business with that Senate I see no one more suitable or even more willing than you, who can act the part of Choragus in the play, for now it seems not more to the interest of the author than yourself to restore what has fallen from the right. But what-

[4] Copernicus was an M.D. and also a Doctor of Canon Law. As counselor of his uncle, Bishop of Ermeland, Copernicus called himself "Decretorum Doctor."

ever you may do, I earnestly request that it be carried out with diligence. If the first pages were reprinted, it seems that a short preface could be written by you, and even attached to those copies which have already been issued to clear them from the vice of calumny. Indeed, I should even like to have prefixed the life of the author, elegantly written by you, which I read some time ago; nor can I add anything to the history, except concerning the end of his life, which came on the ninth of the Kalends of June (May 24th) from a hemorrhage, followed by paralysis of the right side. For many days previously his memory and vigor of mind were gone, nor did he see his complete work except on the day he died when at the point of death. The fact that it came out before his death is not in contradiction, for the year agrees, and the printer has not affixed the day on which the work was finished. I should also like to have annexed your writing in which you most aptly acquit the motion of the earth of disagreement with the Holy Scriptures. Thus you will increase the size of the volume, and also make amends for the misfortune that in the preface of the work your Praeceptor omitted mention of you. But I am not indifferent to you, but a certain slowness and carelessness (less attentive to all things which are not of philosophy) I now recognize, especially languidness coming on, nor am I unmindful of how much you have done in aiding the work and making it easier. For the copies of the work sent me I give thanks to the donor. They will be to me perpetual monuments for holding in memory, not only the author, whom I always held dear, but also yourself, for as you surpassed in energy that toiling Theseus, so now we shall not lack the fruit of the finished work, brought about by your care and solicitude. How much we all owe to you for that zeal of yours is not unknown. I wish you would let me know if the book has been sent to the Sovereign Pontiff, for if not, I should like this duty to the deceased to be carried out. Farewell.

Lobau, July 26, 1543.

There is no record of the date the book was sent to the Sovereign Pontiff, but he must have received a copy sometime, for seventy-three years later it was placed on the Index of Prohibited Books until corrected, for teaching "falsam illam doctrinam Pythagoricam, Divinaeque Scripturae omnino adversantem, de mobilitate Terrae et immobilitate Solis."[5] (The Pythagoreans did not teach that the sun stood still, as Copernicus himself shows in his dedication to the Pope.)

On the four hundredth anniversary of the birth of Copernicus, February 19, 1873, an inscription, of which the following is a translation, was placed in the University of Padua, Italy. (See Domenico Berti's work Copernico, Rome, 1876, page 168, where the original is given.)

[5] See Riccioli's Almagestum Novum, Vol. 2, page 496 (Bologna, 1651), where the corrections to be made are indicated.

NICOLAUS COPERNICUS

OF ASTRONOMICAL SCIENCE FOUNDER
ASCERTAINED THE PLANETARY HARMONY
WITH THE POWER OF GENIUS
PERCEIVED NATURE TO RUN WAYS MORE SIMPLE
RISING TO TRUTH AS TO THE BEAUTY
OF THE STARS SO MANY AND VARIED
DIVINED THE DIURNAL ROTATION
OF THIS THE MEASUREMENT
DEMOLISHED ALL THE ANCIENT DOGMATISM
PLACED THE SUN WHERE TENACIOUS IGNORANCE WISHED THE EARTH
PREPARED THE WORK OF KEPLER GALILEO NEWTON
WHEN YOUNG HAD IN ITALY INSPIRATION DEGREES PROFESSORSHIP
CONSTANTLY PIOUS THE MEDICAL ART LAVISHED ON THE POOR
WHEN DYING HE WAS PRESENTED HIS BOOK
FRUIT OF FIFTY YEARS LABOR HARDLY ISSUED FROM THE PRESS
HE SAW IT SMILED DIED
THE WORLD RECEIVES THE ECHO OF THE GREAT SOUL
AND ON HIS FOUR HUNDREDTH NATAL DAY
THE UNIVERSITY OF PADUA
OF SUCH A GLORIOUS ALUMNUS
CELEBRATES THE MEMORY ON THIS DAY
SACRED TO UNIVERSAL SCIENCE

BORN AT THORN 19 FEBRUARY 1473
DIED AT FRAUENBURG 25 MAY 1543

"Few men, indeed, have done their day's work so well as Nicholas Copernicus. He brought man a step nearer to the truth, and therefore to the Author of all truth; and the name of the obscure Canon of Frauenburg will be for ever memorable as that of him who placed (to use his own stately language) 'the light of the world—the orb which governs the planets in their circulation—upon a royal throne, in the midst of the Temple of Nature.'"—Agnes M. Clerke, Edinburgh Review, July, 1877, page 118.

WASHINGTON, D. C.

The Mass, Density, and Albedo of Eros

By WILLIAM H. PICKERING

Mr. L. Campbell's recent determination of the size of Eros, in which he also confirms the South African conclusions of Messrs. Van den Bos and Finsen that it is really a double body, the two components revolving about one another, enables us at once, making certain plausible conjectures, to determine its mass, density, and albedo. He states that the maximum length of the two bodies is 25 miles by 8 miles in cross section, and that they revolve in a period of $5^h\ 16^m\ 12^s.94$. I have not as yet seen the official publication, but I assume the newspaper figures to be correct. If the two asteroids are 8 miles in diameter, and spherical in shape, their centers are 17 miles apart. Comparing them with the Earth and Moon, whose mean distance apart is 239,000 miles, and their

period of revolution $27^d.32$, we have at once the combined mass of the two asteroids is to that of the Earth and Moon as one to M, where $M = 239{,}000^3 \times 0^2.2196/17^3 \times 27^2.32 = 179{,}000{,}000$. Subtracting 1/80 for the mass of the Moon, we have the mass of the Earth 177 million times that of Eros. Its volume is 1000 million times that of one component, or 500 million times that of the two. Since its density in terms of water is 5.52, we have the density of Eros equals $500 \times 5.52/177 = 15.6$, which is three times higher than that of any other body in the Solar System. In order to reduce the density to that of iron, we should have to increase the dimensions to 27 miles in length, with a diameter of 10 miles for each component. Whether the observations are compatible with that assumption I have no means of knowing. When we get more facts we can get a better value of the albedo of Eros, but by using what we now have, we can obtain at least an idea of it by comparing it with Mars. We shall make use of the following data.

Semi-major axis of the orbit of Mars	1.5237	Magnitude of Mars at mean opposition	−1.85
Semi-major axis of the orbit of Eros	1.4583	Magnitude of Eros at mean opposition	9.7
Diameter in miles of Mars	4230	Diameter in miles of Eros	10
Albedo of Mars	0.15	Albedo of Eros required.	

The ratio of the semi-major axes squared is 1.092. We shall assume that the magnitude of Eros published is that of its two components, therefore the observed magnitude of one component would be 10.45. The area of the surface of Mars is $423^2 = 178900$ times that of Eros. We then see that Mars should be theoretically brighter by 13.04 magnitudes, if situated at the same distance from the observer, assuming the albedo of the two planets to be the same. Consequently the computed magnitude of a single component of Eros should be 11.19. We now see that the computed magnitude exceeds the observed by 0.74, and that Eros therefore would be twice as bright as Mars per square mile of surface if at the same distance from the Sun. Its albedo is therefore 0.30 or about 2/3 that of the Earth. If we take the diameters of the components of Eros as only 8 miles, their albedo would be 0.45. We shall await with interest Mr. Campbell's results based on more accurate data, but in the mean time these approximate figures will show us at least that Eros is a comparatively dark, and perhaps partially oxidized body.

It will be noticed that this is the only asteroid of which we have been able to measure either the mass, density, or albedo. The mass cannot be far out of the way, since the only doubt lies as to the length of 27 miles.

Private Observatory, Mandeville, Jamaica, B. W. I., December 5, 1931.

The Daughter of Mother Earth

By O. J. SCHUSTER

Imagine picking up your daily paper some morning and seeing, in screaming headlines across the front page, the announcement that a daughter had been born to Mother Earth, that the baby world weighed only one-eightieth as much as the mother, that the child's form and face showed rather small resemblance to its parent, and that there was little hope of its growing to the stately stature of the mother. That would be startling, stupendous, unbelievable news.

Incredible as it may appear, the event actually happened. At least our ablest scientists say it did, though at the time of the occurrence there were no newspapers to announce it or earthly eyes and ears to perceive it. Something like a thousand million years have passed since the child was born and only in recent years have men come to realize that Mother Earth has a natural daughter. Even today only a very small number of people are acquainted with the fact and know anything of the remarkable life-history of Earth's only offspring.

The story, however, is so full of interest and enlightenment, enchantment and charm, inspiration and tragedy that its appeal is quite irresistible, once a nucleus of knowledge regarding it has been established.

In our own childhood we were greatly fascinated by the fanciful tales told us by our mothers or other elders about the Moon. The "Man in the Moon" was as real as Cinderella and her fairy godmother. We delighted in tracing out the man's face and were even able to locate his dog. At other times a sprightly fancy transformed the pale Moon into a "silver boat sailing through the sky" and carrying riches untold, just as in other moods Santa Claus, his reindeer, and his magic sled laden with wondrous gifts for all the children of Earth, were realities to us.

As we grew older we put aside our childish pictures of the Moon, but we retained her poetic names of "Cynthia" and "Queen of the Night." And now, having discovered that Cynthia is in reality a daughter of Mother Earth, that she is the child of a remarkable romance that developed between her mother and the Sun, the old interest is reawakened and intensified. Even a prosaic scientist delights in the discovery that in her youth Mother Earth was a spirited maiden who danced with the princely Sun, yielded to his attraction, became his bride, and that Cynthia was born of this union. That is romance more thrilling, and at the same time more human, than any fairy tale.

It is possible to reconstruct, in very general outline, the story of Cynthia's career. A billion years or so ago when the Moon began its separate existence the Earth was still in its youth, though even then it was something like a thousand million years old. During the long period of its childhood the Earth passed from gaseous to liquid form. At the

time it gave birth to the Moon it was in a molten state, highly plastic throughout. It rotated on its axis in a much shorter period than it does now and this fact is closely connected with the birth of the Moon, as is also the fact that it was in a liquid state.

From the very beginning of the Earth's existence the Sun raised tides upon its surface, just as the Moon does today. When the surface of our planet was one vast sea of molten lava the tides were far higher and more extensive than later when a solid crust had formed over the globe. Tides act as a brake, because of the friction resulting as they sweep around over the equatorial belt in a direction directly opposite to that of rotation, and thus slow-up the daily motion. Time was when the Earth may have rotated in less than 3 hours. In the course of ages the period was lengthened to 3½ hours. When the stage was reached in which rotation occurred in 4 hours or a little less Mother Earth responded more sympathetically to the Sun's attraction than at any previous or any subsequent period of time.

It must be remembered that two tidal waves existed at the same time, one crest directly under the Sun, the other on the side of the Earth directly opposite to the Sun, and that these two waves followed each other around the globe constantly, each completing its circle in the same time required for a rotation. Thus when the Earth turned on its axis once in 4 hours the tidal crests followed each other at intervals of 2 hours, and the time between high tide and low tide was 1 hour. This was just the time required for such gigantic waves, reaching half way round the Earth, to naturally rise and fall. In other words, they were then swinging up and down in unison with the pull of the Sun. Under these conditions they would steadily increase in height and power, much as a child's swing is made to sweep over an ever-increasing arc by timing each push or pull so that it is in cadence with the natural motion of the swing.

This swinging up-and-down motion of the tidal waves increased in range and power for many years but at last the upward swing was so great that the huge crest of molten earth broke away with such momentum that it could not return to the body of Mother Earth but revolved around it at a relatively short distance above the surface. Thus was the Moon born.

Being born of the Earth, the body of the Moon was necessarily of the same material—earth, water and air. Like the Earth at that time, it would be in a molten condition, too hot for water to remain on its surface. All the water would therefore be distributed through the air, forming an atmospheric envelope around the body of the Moon.

As already stated, the Moon's mass was only one-eightieth that of the Earth. Measured in units with which we are more familiar, the Moon really has a considerable body, for its diameter is more than 2,100 miles and its circumference is nearly 6,800 miles. Irregular in form at the time of birth, it gradually grew in symmetry until it became round and

shapely as we see it now. This change to spherical form inevitably resulted from the Moon's own gravity and its liquid condition. Unlike human infants, the Moon could not grow in size and even became smaller as time passed because its heat was gradually dissipated into surrounding space, causing it to shrink as it cooled.

In the course of time it cooled sufficiently to form a solid crust over its surface, thin at first but becoming thicker and thicker as it lost more of its heat. Just as the skin of an apple while baking wrinkles because it is too large for the body within, so the Moon's crust had to wrinkle in order that it might continue to rest on the smaller interior. Some wrinkles would naturally be larger and longer than others, some would be broad and low while others would be relatively narrow and high. When the crust had cooled below the boiling point of water some of the water, falling as rain, remained on the surface, forming pools in the depressions. With further cooling more water accumulated on the surface, the pools grew into ponds and lakes and, finally, into seas. The broad wrinkles became plains and plateaus and the narrow ones mountain ranges. Thus were the waters gathered together and the dry land made to appear.

In the warm waters of those primeval pools life may have appeared, very simple at first but in the course of millions of years growing more and more varied and abundant. As the rain fell upon the land-surface a little of the rocky crust would be transformed into soil, a part of which would be carried to lake and sea shores. Thus the land would be prepared for plant life and the living forms along the shores would experience alternate periods of dryness and wetness, adjusting themselves to both conditions (as some of our plants and animals on Earth have done), or migrating gradually away from the waters and living permanently on the land. We may give free play to our imagination and fancy life evolving to ever higher forms until beings as intelligent as men, and perhaps more intelligent, inhabited the Moon.

If the Moon was ever the seat of intelligent life, it must be profoundly regretted that it no longer is. Man talks glibly of signalling to Mars and even of journeying to that planet, but the obstacles to such a project are insurmountable in our present state of knowledge. When nearest to Earth, Mars is still 35,000,000 miles away. The Moon, on the other hand, is relatively very near, being less than a quarter of a million miles from the Earth. It is so near that through our largest telescopes objects as large as our biggest buildings would be readily distinguishable, a city would be recognized by its illumination, growing crops by their seasonal changes, moving trains and boats by their trail of smoke, and in a thousand ways we should become aware of the activities of intelligent beings. Signalling to Mars is at present far beyond our reach but communication with intelligent beings on the Moon would be easily realized. The very thought of exchanging experiences with beings of another world is entrancing. What a flood of new light would illuminate our own

existence if we could add the literature, science, philosophy, religion of beings of another world to our own? No longer would we feel ourselves marooned on a little floating island in a limitless sea of space but, having become acquainted with a friendly neighbor, our loneliness would vanish and, in coöperation with our new-found friends on the neighboring world, we would seek new and larger adventures in the expanding universe opened to our view.

In the years to come when man has greatly increased his knowledge and mastery of nature, expeditions to the Moon may become feasible. Exploration on its surface may then be undertaken. The discoveries made in such an adventure would be only a little less thrilling than direct communication with its inhabitants over a distance of nearly a quarter of a million miles. If such expeditions ever succeed, the discovery of fossils and other remains of life that once flourished there may be the key with which posterity may solve the mystery now locked within the impenetrable walls that encase this dead world.

The physical changes the Moon passed through are as remarkable as the development of life on its surface, as we have imagined it. From the time of its separation from the Earth tides were formed on both bodies as the result of their mutual attraction. The nearness of the two would make these tides a much more powerful brake to rotation than those raised on the Earth by the Sun. The tides raised by the Moon have gradually retarded the rotation of the Earth so that instead of turning on its axis once in 4 hours it now takes 24 hours. Because of the Earth's greater mass, the tides it raised on the Moon were still larger and more effective. They have, in fact, brought the tidal wave to a complete stop, its crest now permanently facing the Earth. In other words, whatever the Moon's rate of rotation may have been in the beginning it has been retarded so that the same face of the Moon is always turned to the Earth and its opposite side has never been seen by man.

Along with the change in rotation went a change in the distance between the two bodies. To keep the balance of momentum between them they had to recede from each other, and as the Moon's orbit increased in size the satellite's time of revolution also increased. Revolving around the Earth at first in nearly the same time our planet then rotated, the period grew longer and longer until now it is a little over 27 days. The process will continue until the Moon is much farther from the Earth than at present and until, millions of years hence, the Earth's rotation has been so retarded that it will always present the same face to the Moon, just as the Moon now always presents the same face to the Earth. When that stage is reached the reverse process will set in and the two bodies will again approach each other and once more be so near each other that the Earth's attraction may rend her child asunder, convert her into dust and distribute it about herself as now are the rings of Saturn, or perhaps draw unto herself all that remains of her daughter.

While the changes we have sketched were going on, the surface of

the Moon also underwent important changes. We have already seen how the crust wrinkled as loss of heat caused the interior to shrink. In time it became increasingly difficult for the thickening crust to fold into ridges, but the pressure became greater and greater until readjustment took place. The folding would occasionally be accompanied by slipping of the rock layers far below the surface, causing violent shocks and quakes, or perhaps great cracks through which extensive masses of molten rock poured out and spread over vast areas. Here and there volcanic eruptions occurred, growing in violence and extent as the outer shell thickened and hardened. The final chapter in this process was tragedy, appalling in nature and extent. The volcanic explosions became inconceivably vehement, tearing holes or craters of tremendous size in the crust, hurling mountains of rocky material to vast heights, which, as it fell back, formed great rims around the enormous craters or dropped into the openings to be remelted and perhaps again hurled into space. The effect of such explosions would be far greater on a small body like the Moon than on a mass the size of the Earth because of the difference in gravity. Volcanic explosions on Earth have been known to shoot material to a height of 40 miles or more, but an explosion of like force on the Moon would hurl objects 250 miles above its surface. There is reason to believe that some of the rocky material shot upward with such force that it passed beyond the power of the Moon's attraction and wandered off into space or fell to Earth as meteors.

More than 100,000 craters cover the surface of the satellite, most of them so large as to make the largest on Earth mere dwarfs in comparison. The crater on the top of Vesuvius is less than a half-mile across, while some of those on the Moon are more than 60 or 80 miles in diameter. Were we to stand on the rim of one of these great holes the view would be truly terrifying, especially as we looked into the awful abyss whose bottom might be 3 or even 4 miles below us. Were Mt. Vesuvius placed on the floor of that crater it would be a less conspicuous object than a small thimble placed on the bottom of a large washtub, and the crater on its summit would hardly be visible. So abundant are these craters in the most mountainous parts that they overlap and merge into each other, and many of the mountain ranges greatly exceed those on Earth in their towering proportions.

Our poets have ascribed some of the wildest landscapes on Earth to the mad fury of the devil. Some Power greater than that of Satan carved and sculptured those majestic and, at the same time, appalling features of the daughter of Mother Earth.

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A Note On the Quantization of the Solar System

By A. E. CASWELL

In April, 1929, the author published a note in *Science* in which he drew attention to the fact that the square-roots of the distances of the planets from the sun are approximately proportional to a series of simple integers. For the first six planets and the asteroids the series is 3, 4, 5, 6, 8, 11, and 15. The third column of Table I exhibits this relationship. Uranus and Neptune do not fit into the series satisfactorily, but taken by themselves the ratio of the square-roots of their distances is found to be very close to four-fifths.

It seems this law had been stated ten years previously by Dufton in England. Quite recently Penniston has published an article in which he claims that another closely related series gives a better agreement with observed distances, but the conclusion is open to question.

The above-mentioned discovery suggested Bohr orbits and raised the question of a possible quantization of the solar system. The general problem of the motion of a number of bodies moving in a gravitational field of force has never been solved, although some progress has been made in that direction. Lagrange has shown that an asteroid may move in an orbit approximately identical with that of Jupiter, with the same period as Jupiter and in such a position that the asteroid, the sun, and Jupiter lie at the corners of an equilateral triangle. The asteroids of the Trojan group approximately fulfill this condition. If any quantization principles can be found, they may result in limiting the possible solutions to such an extent that the problem will become tractable.

The application of the theorem of the equipartition of energy leads to the conclusion that the gravitational interaction of two masses upon each other will tend to equalize their energies. Thus we find that the energies of the stars are of the same order of magnitude irrespective of their masses.

We have computed the energies of the planets and their satellites, and the results for the planets are shown at the right in Table I. Three distinct orders of magnitude appear. Mercury and Mars fall in a class with their average energy only about one-tenth that of the next group, which includes Venus, Earth, Uranus, and Neptune. Jupiter and Saturn are in a class by themselves, Saturn having ten times the energy of the earth and Jupiter six times as much as Saturn. Within a given classification it appears that the energies of the planets are approximately proportional to simple integers. Thus the earth has eight-ninths the energy of Venus, Uranus three-fourths that of the earth, Neptune three-fourths that of Uranus and half that of Venus.

Table II gives the same data for Jupiter's satellites as Table I gives for the planets. Again we find that the square-roots of the distances of the satellites are proportional to simple integers and that they also fall into two sets. Of course, it is obvious that if we were to select the smallest integer large enough and with sufficient discrimination, it would be possible to get a much more perfect fit and at the same time include all the planets or a group of satellites in a single series. But if we were to do this, the whole tabulation would lose its significance.

Table II also shows the ratios of the energies of Jupiter's satellites so far as known. These also correspond to integers with about the same accuracy as the primary observations. The various possible combinations to form simple ratios will be noted.

Table III shows that similar distance and energy relations are true for the satellites of Saturn, but the masses of satellites VI and II are

TABLE I.

DISTANCE AND ENERGY RATIOS FOR THE SOLAR SYSTEM.

Planet	Semi-major Axis Orbit Earth = 1	Ratios of Sq.-Rt. of Orbits	Reciprocal Masses Sun = 1.0	Ratios of Energies Mass/Axis	Approximate Integral Energy Ratios	
Mercury	0.3871	3.018	8,000,000	3.229	3.03m	3m
Venus	0.7233	4.125	410,000	33.72	17.83v	18v
Earth	1.0000	4.851	331,950	30.13	15.93v	16v
Mars	1.5237	5.988	3,085,000	2.127	2.00m	2m
Planetoids	2.7(?)	7.97				
Jupiter	5.2028	11.06	1047.40	1831.	6.11j	6j
Saturn	9.5388	14.98	3499.	299.6	1.00j	1j
Uranus	19.1910	21.25	22,650	23.01	12.16v	12v
Neptune	30.0707	26.60	19,350	17.19	9.08v	9v
Uranus		4.000			4.02n	4n
Neptune		5.008			3.00n	3n

TABLE II.

DISTANCE AND ENERGY RATIOS FOR JUPITER'S SATELLITES.

Satellite	Dist. from Planet in Miles	Ratios of the Square-roots of Distances		Integer	Mass Moon = 1	Ratios Energy = M/D	Ratios Energy Calc.	Integer
V	112,600	1.000	2.036	2				
I (Io)	261,800	1.525	3.105	3	1.09	4.165	7.96	8
II (Europa)	416,600	1.923	3.916	4	0.65	1.560	2.98	3
III (Ganymede)	664,200	2.429	4.945	5	2.10	3.162	6.06	6
			3.01	3				
IV (Callisto)	1,168,700	3.222	3.99	4	0.58	0.497	0.95	1
VI	7,114,000	7.949	9.84	10				
VII	7,292,000	8.044	9.96	10				
VIII	14,600,000	11.39	14.09	14				
IX	15,000,000	11.54	14.29	14				

TABLE III.

DISTANCE AND ENERGY RATIOS FOR SATURN'S SATELLITES.

VII (Mimas)	115,300	1.000	7.06	7	1/2120	4.09	0.80	1
VI (Enceladus)	147,800	1.131	7.98	8	1/520?	13.01	2.54	2-3
V (Tethys)	183,000	1.260	8.89	9	1/119	45.9	8.98	9
IV (Dione)	234,400	1.427	10.07	10	1/69	61.8	12.10	12
II (Rhea)	327,300	1.684	11.89	12	1/30?	101.9	19.93	20
I (Titan)	758,800	2.565	18.10	18	1.86	2453.		
VIII (Hyperion)	919,700	2.823	2.00	2				
III (Iapetus)	2,210,000	4.373	3.10	3				
IX (Phoebe)	8,034,000	8.343	5.91	6				

uncertain, resulting in corresponding uncertainties in their energies. Table IV gives the distance and energy data for Mars and Uranus.

Both the linear and angular momenta have been computed for the planets, but we have failed to observe any significant relations between them.

It has been shown that on account of gravitation the presence of inner planets tends to decrease the period of a planet while the presence of outer planets tends to increase it. Thus Saturn, Uranus, and Neptune somewhat more than offset the effect of the smaller inner planets upon Jupiter's period, so that it is about one-and-one-half hours longer than we should expect from Kepler's third law. On the other hand, Jupiter's effect upon Saturn is so great that the latter's period is decreased nearly one week.

It might be surmised that the attraction between planets would tend to cause their periods to become multiples or sub-multiples of one another, thereby producing a sort of resonance. This resonance might give to a relatively small planet such an amplitude of vibration as to throw it entirely out of its orbit. We find an apparent illustration of such a possibility in the fact that no asteroids occur with periods which are one-half, one-third, or two-fifths that of Jupiter. The Trojan group is an illustration of exact synchronism with Jupiter, and most of the asteroids with periods greater than seven years have periods approximately two-thirds or three-fourths that of Jupiter. In these latter cases they appear to have been brought into resonance but the effect of resonance is not sufficient to throw them out of their orbits.

Dufton, in the article previously mentioned, points out what is obvious from Kepler's third law, that if the distances of the planets are approximately proportional to the squares of integers, the periods must be proportional to the cubes of the same integers. However, any deviations from the exact squares in the case of the distances will be matched by greater deviations in the case of the periods, not to mention deviations caused by gravitational perturbations. The simplicity of the relations between the periods of some of the satellites makes it difficult to cling to a simple cubed-integer relation.

Tables V to VIII, inclusive, show the relations between the periods of the planets and between the periods of their respective satellites. Table V, column 3, gives the ratios of the periods of adjacent planets. The remaining three columns at the right show how the periods may be classified into a number of simple systems. There seems to be an indication that the periods may be arranged in two sets roughly proportional to simple integers. A cursory glance at column 3 of Table VI shows that the same is true of Jupiter's satellites. Table VII for Saturn and Table VIII for Mars and Uranus also point to the same generalization.

The author has computed the probability that the ratios of successive periods would lie within 0.01 of whole numbers, or of the fractions ½, ⅓, ¼, and so on to 1/10, or any multiples of these ratios, and finds

that the actual occurrence is four times that predicted for whole numbers and halves, and three times that for thirds, but is zero for fourths, fifths, sixths, and sevenths, not included in the preceding ratios. For other ratios the observed and predicted agree.

In conclusion, we may say that the data assembled in these tables seem to indicate three tendencies operating in the gravitational field. First, bodies tend to adjust their distances from the central mass so that the distances of neighboring bodies are proportional to the squares of simple integers. In one system of satellites there may be more than one series of such integers. Second, bodies tend to divide their total energy so that bodies with the energies of the same order of magnitude have amounts which are proportional to simple integers. This is a modification of the equipartition theorem. Third, the periods tend to bear simple ratios to one another. The period of the outermost satellite is too small to give an exact simple ratio. This is because of the unbalanced effect of the inner satellites.

It is obvious that with bodies having random masses these tendencies cannot be simultaneously realized. At best we have a compromise, but in attacking the problem of three or more bodies it seems that an empirical solution which comes nearest to meeting all three of these conditions is more likely to be a theoretically correct one than any other.

TABLE IV.

DISTANCE AND ENERGY RATIOS FOR SATELLITES OF MARS AND URANUS.

Satellite	Dist. from Planet in Miles	Ratios of the Square-roots of Distances		Integer	Mass Moon = 1	Ratios Energy = M/D	Ratios Energy Calc.	Integer
MARS								
Phobos	5,826	1.000	5.00	5			16.5?	
Deimos	14,580	1.582	7.91	8			1.00	
URANUS								
I (Ariel)	119,100	1.000	4.00	4				
II (Umbriel)	165,900	1.180	4.72	5				
III (Titania)	272,200	1.511	6.04	6				
IV (Oberon)	364,000	1.748	6.99	7				

TABLE V.

RELATIONS BETWEEN THE PERIODS OF THE PLANETS.

Planet	Period in Sidereal Years	Ratios of Successive Periods	Approximate Integral Ratios	Periodic Times in Arbitrary Units	
Mercury	0.2408				1.933
		2.555	2-5 or 9-23		
Venus	0.6152			0.983	4.940
		1.627	3-5 or 8-13		
Earth	1.0000		or 5-8		8.030
		1.8808	8-15		
Mars	1.8808			3.005	15.10
		6.308	3-19		
Jupiter	11.862			18.95	2.004
		2.482	2-5		
Saturn	29.457			47.06	4.975
		2.853	5-14		
Uranus	84.013				14.19
		1.961	1-2		
Neptune	164.783				27.84

TABLE VI.

RELATIONS BETWEEN THE PERIODS OF JUPITER'S SATELLITES.

Satellite	Period in Minutes or Days	Ratios of Successive Periods	Approximate Integral Ratios	Periodic Times in Arbitrary Units	
V	717.38m			1.965	
		3.5512	2-7 or 9-32		
I (Io)	2,547.56m			6.974	2.97
		2.0074	1-2		
II (Europa)	5,113.70m			14.00	5.96
		2.0147	1-2		
III (Ganymede)	10,302.56m			28.16	12.00
		2.3326	3-7		
IV (Callisto)	24,032.18m			0.999	28.00
	or 16.689d	15.02	1-15		
VI	250.68d			15.00	
		1.038	25-26		
VII	260.06d			15.57	
		2.841	5-14		
VIII	738.9d			44.22	
		1.008			
IX	745.0d			44.59	

TABLE VII.

RELATIONS BETWEEN THE PERIODS OF SATURN'S SATELLITES.

Satellite	Period in Minutes or Days	Ratios of Successive Periods	Approximate Integral Ratios	Periodic Times in Arbitrary Units	
VII (Mimas)	1,357.09m			1.0000	
		1.4539	2-3 or 9-13		
VI (Enceladus)	1,973.11m				1.0000
		1.3777	5-8		
V (Tethys)	2,718.44m			2.0031	
		1.4598	2-3 or 9-13		
IV (Dione)	3,941.16m				1.9975
		1.6505	3-5		
II (Rhea)	6,505.20m				
		3.5299	2-7		
I (Titan)	22,961.45m			3.000	
		1.3343	3-4		
VIII (Hyperion)	30,638.40m			4.004	
		3.7285	4-15		
III (Iapetus)	114,236.41m			14.92	
	or 79.33d	6.9387	1-7		
IX (Phoebe)	550.44d				

TABLE VIII.

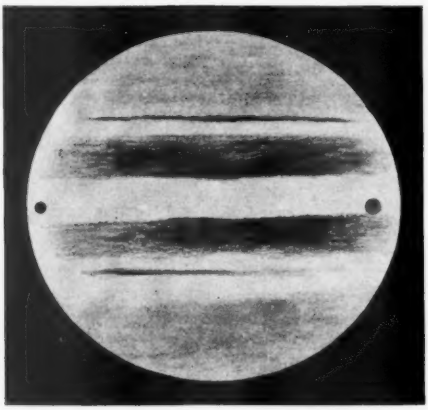
RELATIONS BETWEEN THE PERIODS OF THE SATELLITES OF MARS AND URANUS.

Satellite	Period in Minutes	Ratios of Successive Periods	Approximate Integral Ratios	Periodic Times in Arbitrary Units	
MARS					
Phobos	459.53				
		3.956	1-4		
Deimos	1,817.91				
URANUS					
I (Ariel)	3,629.35			6.082	12.164
		1.6443	3-5 or 8-13		
II (Umbriel)	5,967.61			10.000	20.000
		2.1008	1-2 or 10-21		
III (Titania)	12,536.44			21.008	42.016
		1.4938	2-3		
IV (Oberon)	18,727.06				63.77

The Total Eclipse of Jovian Satellite I by III on 1931 December 2

By G. VAN BIESBROECK

Mutual eclipses of the four brighter satellites of Jupiter are not such rare occurrences as one might think from the paucity of past observations of these curious phenomena. Not until 1926 were there any ephemerides predicting such phenomena. In that year the Computing Section of the British Astronomical Association undertook to establish these predictions with the result that several of the phenomena were observed quite generally. Under the chairmanship of Major A. E. Levin this active Section has again issued in the "Handbook" for 1931 and 1932 the necessary ephemerides for predicting the eclipses and occultations occurring during the period September, 1931, to July, 1932.



JUPITER'S SATELLITE I TOTALLY ECLIPSED BY III, DECEMBER 2, 1931.

Thanks to these predictions I was fortunate in observing with the 12-inch telescope of the Yerkes Observatory the total eclipse of Satellite I (Io) by Satellite III (Ganymede) on December 2, 1931, *while both satellites were projected on the disc of the planet.* The sky was transparent but the images were unsteady so that I could not use to advantage a power higher than 240. The beginning of the transit of Satellite III over the disc of the planet was watched at $6^h\ 52^m$ U.T. At that hour Satellite I was already in transit; it had entered the disc at $5^h\ 8^m$ and was to leave it at $7^h\ 25^m$ so that the approximate place where it was projected on the planet was known; but no trace of the satellite could

be seen. The prediction of the eclipse of Satellite I by Satellite III was as follows: Penumbra begins at $7^h\ 4^m$, shadow begins at $7^h\ 7^m$, shadow ends at $7^h\ 30^m$, penumbra ends at $7^h\ 33^m$. Careful watch was kept for the eclipsed satellite after 7^h. At $7^h\ 7^m$ no trace of the satellite was visible yet. At $7^h\ 8^m\ 30^s$ a first glimpse of a small black dot was seen near the west rim of the disc; it rapidly increased in size and at $7^h\ 10^m$ appeared as a little black bar normal to the equator of the planet. It became gradually wider until, as far as the conditions permitted to tell, the disc appeared fully eclipsed at $7^h\ 18^m$. The accompanying sketch made at that time shows this curious configuration. To the right (east) we see Ganymede (III) as a gray disc of very appreciable size, nearly tangent to the southern rim of the north tropical belt. At the opposite side and a little farther away from that belt is the black disc of Io, its blackness reminding one of that of Mercury in transit across the Sun. No effort was made to represent the fine details of the structure of the belt which could be seen during short intervals of sharp definition; the sketch gives only the general appearance of the belts.

Soon after this ($7^h\ 23^m$) Satellite I began to be more difficult to see since its image was immersed in the blurring fluctuations of Jupiter's edge, but at $7^h\ 25^m\ 20^s$ a little luminous meniscus appeared, detached from the rim although quite close to it. Its brightness seemed then hardly as much as that of a 9^M star. But as it moved away from the rim it gained rapidly in luminosity and already at $7^h\ 30^m$ the unsteadiness of the images made it hard to see any deficiency to the disc or to the brightness of the satellite. As far as can be made out from these observations the circumstances of the eclipse occurred exactly as predicted. It would have required much better seeing to establish more correctly the times of the various phases.

WILLIAMS BAY, WISCONSIN.

Planetary Phenomena in 1932

By HERBERT C. WILSON

ECLIPSES.

During this year there will be four eclipses, two of the sun and two of the moon. The third of these, a total eclipse of the sun, August 31, will be of especial interest to those living in the eastern part of the United States and Canada, since the path of totality passes across thickly populated regions and there are many favorable localities for observing the eclipse, easily accessible both by train and by automobile. The duration of the total phase of the eclipse will vary from $1^m\ 44^s$ at the southeast coast of Hudson's Bay to $1^m\ 38^s$ at the coast of Maine. For details as to possible observing stations and probable weather conditions, the reader is referred to the report of a committee appointed by the American Astronomical Society, printed in the November, 1931, issue of POPULAR ASTRONOMY.

There will doubtless be many observers from foreign countries as well as

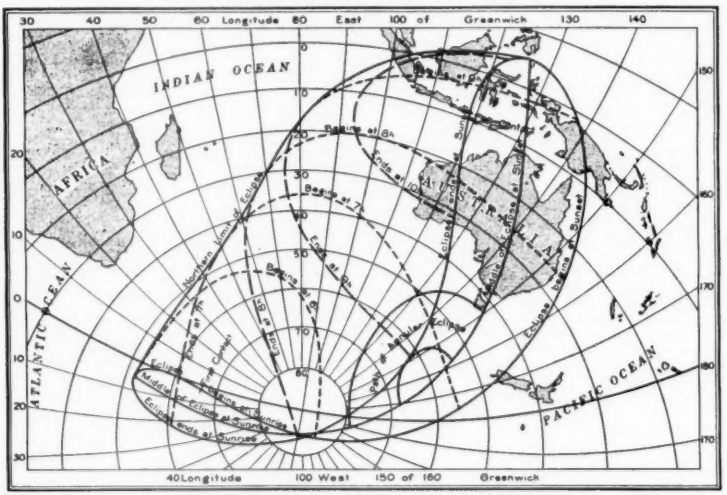
from all parts of the United States gathered along the middle line of the path of totality, especially in the province of Quebec and in Vermont, New Hampshire, and Maine. The chances of clear weather appear to be a little better than fifty per cent.

The following data concerning the four eclipses are taken from the *American Ephemeris and Nautical Almanac* for 1932:

I. An Annular Eclipse of the Sun, March 7, 1932.

This will be visible as a partial eclipse in Australia and some of the Malayan Islands. The path of this annular eclipse lies wholly on the ocean extending from the southern coast of Tasmania to about ten degrees from the South Pole. The duration of the annular phase will be relatively long, lasting $5^m\ 19^s$ at the middle of the eclipse. The region is shown in Figure 1.

ANNULAR ECLIPSE OF MARCH 7, 1932.



NOTE:—The hours of beginning and ending are expressed in Greenwich Civil Time

Figure 1.

Circumstances of the eclipse:

		G.C.T. d h m	Longitude from Greenwich ° ′	Latitude ° ′
Eclipse begins	March	7 5 31.0	+ 2 14	—66 14
Central eclipse begins		7 7 27.1	+179 13	—74 37
Central eclipse ends		7 8 24.2	—152 29	—47 08
Eclipse ends		7 10 20.1	—118 39	— 9 34

II. A Partial Eclipse of the Moon, March 22, 1932.

This will be invisible at Washington; the beginning visible generally in eastern Asia, Australia, the Pacific Ocean, North America except the northeastern part, and the extreme western part of South America; the ending visible generally in Asia except the southeastern part, the Indian Ocean, the Pacific Ocean, and the extreme northwestern part of North America.

The eclipse will be nearly total, 0.973 of the moon's diameter being covered by the shadow of the earth at the middle phase.

Circumstances of the eclipse:

	G.C.T. d h m
Moon enters penumbra	March 22 9 58.7
Moon enters umbra	22 10 59.2
Middle of the eclipse	22 12 32.2
Moon leaves umbra	22 14 05.2
Moon leaves penumbra	22 15 05.6

III. A Total Eclipse of the Sun, August 31, 1932.

This will be visible as a partial eclipse over eastern Siberia, all of North America and Greenland, and the northern part of South America. The path of totality passes across the Arctic Ocean, thence southeasterly over Hudson's Bay, the Province of Quebec, between Montreal and Quebec, across northern Vermont, central New Hampshire, and the southwestern part of Maine, thence curves more easterly, ending in the middle of the Atlantic Ocean.

The region is shown in Figure 2.

TOTAL ECLIPSE OF AUGUST 31, 1932.

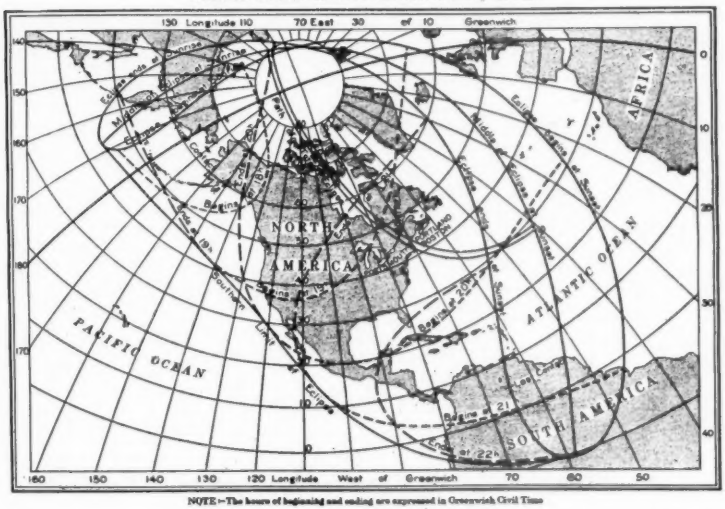


Figure 2.

Circumstances of the eclipse:

		G.C.T. d h m	Longitude from Greenwich ° ′	Latitude ° ′
Eclipse begins	August	31 17 44.5	—169 18	+59 15
Central eclipse begins		31 19 04.2	—109 16	+79 36
" at local apparent noon		31 19 16.8	+109 10	+78 36
Central eclipse ends		31 21 02.6	+ 40 59	+28 27
Eclipse ends		31 22 22.1	+ 64 45	+ 5 00

IV. A Partial Eclipse of the Moon, September 14, 1932.

This will be invisible at Washington; the beginning visible generally in Europe, Africa, the eastern part of the Atlantic Ocean, the Indian Ocean, Asia,

and Australia; the ending visible generally in the northeastern part of North America, South America, the Atlantic Ocean, Europe, Africa, western Asia, and the Indian Ocean.

The eclipse will be nearly total, 0.982 of the diameter of the moon's disc being covered by the earth's shadow at the middle of the eclipse.

Circumstances of the eclipse:

	G.C.T. d h m
Moon enters penumbra	September 14 18 05.2
Moon enters umbra	14 19 18.2
Middle of the eclipse	14 21 00.5
Moon leaves umbra	14 22 42.8
Moon leaves penumbra	14 23 55.7

The Sun.

The sun will be nearest the earth on January 2 at 4^h Greenwich Civil Time. It will enter the sign Aries on March 20 at $19^h\ 54^m$, Greenwich Civil Time, when technically the spring season begins. Summer begins June 21, at $15^h\ 23^m$ G.C.T., when the sun enters the sign Cancer. The sun will be farthest from the earth, or the earth will be at aphelion, on July 3 at 20^h G.C.T. Autumn begins September 23, as the sun enters the sign Libra, at $6^h\ 16^m$ G.C.T. and winter begins December 22, $1^h\ 15^m$ G.C.T., with the sun entering the sign Capricornus.

The Planets.

The apparent movements of the planets along the ecliptic during the year are shown in the Figures 3, 4, 5, and 6, which have been prepared with the aid of the constellation charts, SC1, furnished through the courtesy of the Eastern Science Supply Co. On these star charts the courses of the planets have been plotted from the data of the *American Ephemeris*.

Mercury.

The course of Mercury is shown by the smooth black line in Figures 3 and 4. As Mercury circles about the sun three times during the year it must pass between the sun and the earth three times. At these times it apparent motion is westward (retrograde) instead of eastward. As the orbit of Mercury is tilted seven degrees from the plane of the earth's path around the sun, the combination of reverse motion and tilt seen from the earth from different directions produces the effect of three quite different loops in the projection of Mercury's path against the background of the sky. Mercury begins the year in the constellation Scorpio, thence passes eastward through Sagittarius, crossing the ecliptic on January 22, thence through Capricornus and Aquarius; makes a loop in Pisces in April, crosses the ecliptic April 19, is farthest south from the ecliptic May 19, again crosses the ecliptic to the north June 7; makes a second loop in August, in the constellation Leo, crossing the ecliptic twice near the same point. The third loop is made in November and December, in Scorpio. The three dates when Mercury passes between earth and sun, *i.e.* is at inferior conjunction, are: April 10 at 11^h, August 17 at 14^h, and December 4 at 17^h, G.C.T. The planet will be at superior conjunction, *i.e.* almost directly behind the sun, on February 26, June 13, and September 29.

The dates when Mercury may most easily be seen in the evening sky shortly after sunset, will this year be those in the vicinity of March 23 and July 20. The dates most favorable for morning observations of Mercury will be about May 8.

Venus.

The path of Venus is indicated in Figures 3 and 4 by the line made up of dashes to distinguish it from the path of Mercury. Venus begins the year in Capricornus and moves northeasterly through the succeeding constellations of the Zodiac until June 7 when it begins reverse motion, making a loop in the constellation Gemini. It will be at inferior conjunction June 29 at 5^h, G.M.T., and will continue a retrograde motion until July 20. After that it will move eastward and slowly southward, ending the year in Scorpio. Venus will be at its greatest brilliancy as evening star May 22, when its stellar magnitude will be —4.2, *i.e.* it will be over 100 times as bright as the standard first magnitude star and about 11 times as bright as Sirius. It will be of the same brightness again as morning star about August 5. It will be farthest east from the sun (45° 42′) on April 19, and farthest west from the sun (45° 58′) on September 7.

Mars.

The apparent course of Mars is shown in the chart, Figure 5. It begins the year in Sagittarius and follows the ecliptic quite closely, ending the year in the eastern part of Leo. Mars does not come to opposition this year, so there is no loop in its path but the slowing of its motion in December indicates that there will be a loop in the path early next year. Mars will be in conjunction with the sun on February 1, 1932. During November Mars will be comparatively near the star Regulus in Leo. The two objects will be of nearly the same degree of brightness and it will be interesting to compare their colors as well as brightness. On November 10 Mars will be only a degree and a half north of Regulus. The magnitude of Regulus is 1.34 while that of Mars varies from 1.2 on November 1 to 0.9 on December 1.

Jupiter.

The path of Jupiter is shown in Figure 6. The motion is northwestward until April 8 then southeastward through the constellation Leo during the remainder of the year, slowing up in December preparatory to retrograde motion in January of the next year. Jupiter will be at opposition to the sun on February 7 and so will be very favorably situated for observation during the winter and spring. Its stellar magnitude at this time is —2.0 to —2.1, so that it is about one and a half times as bright as Sirius. Toward the end of the year it will be interesting to compare Jupiter with Mars and Regulus, when they are in the vicinity of each other. The four bright moons of Jupiter and the ruddy belts are always fascinating objects to study by amateurs who have telescopes of sufficient power to show them well. A conjunction of Jupiter and Venus will occur on October 20 at 3^h, G.C.T., when Venus will be only 7′ south of Jupiter.

Saturn.

Saturn's path lies in the constellation Capricornus, the motion being eastward until May 15, then westward until October 2 and eastward for the rest of the year. Saturn will be in conjunction with the sun January 17 and at opposition July 24. The low altitude of the planet is unfavorable to observations by northern observers. Those in the southern hemisphere have a better opportunity except that there the opposition occurs in the winter season. The rings of Saturn at the time of opposition will be tilted at an angle of over 20° to the line of sight from the earth so that their details ought to be well seen at favorable moments. The stellar magnitude of Saturn varies from +0.8 at the beginning of the year to +0.3 at the time of opposition. It will thus be brighter than the nearest bright

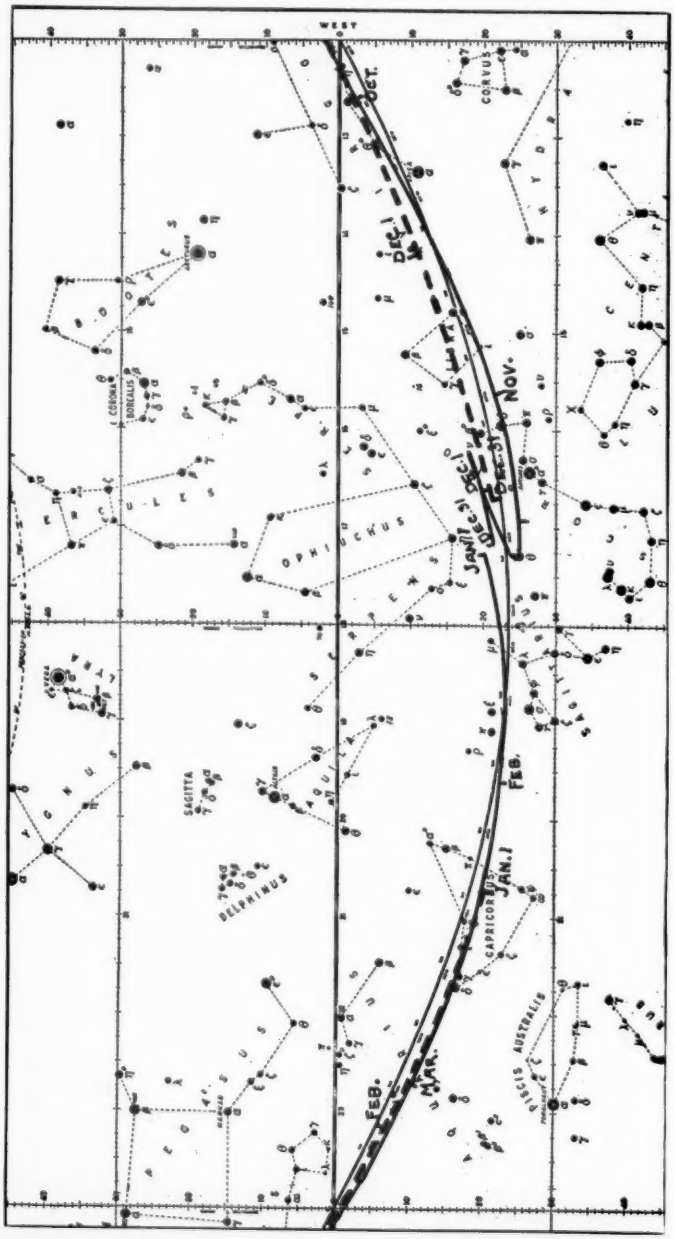


FIGURE 3.
APPARENT PATHS OF MERCURY AND VENUS IN 1932.

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APPARENT PATHS OF MERCURY AND VENUS IN 1932.

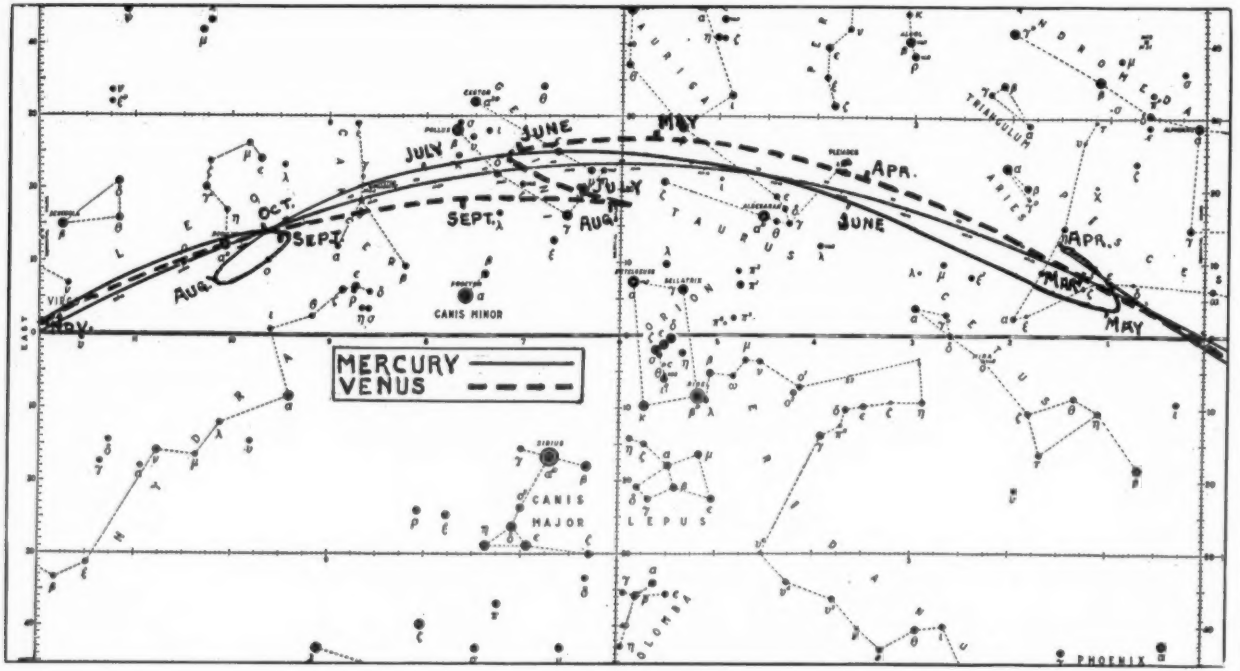


FIGURE 4.
APPARENT PATHS OF MERCURY AND VENUS IN 1932.

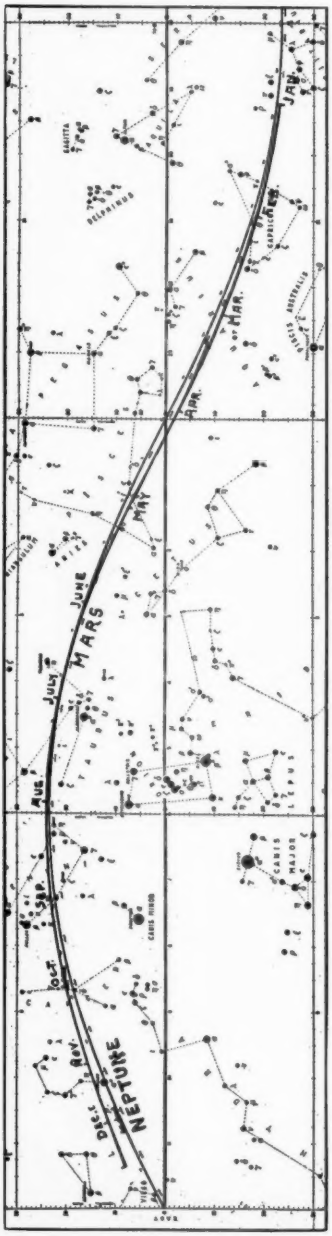


FIGURE 5. APPARENT PATHS OF MARS AND NEPTUNE IN 1932.

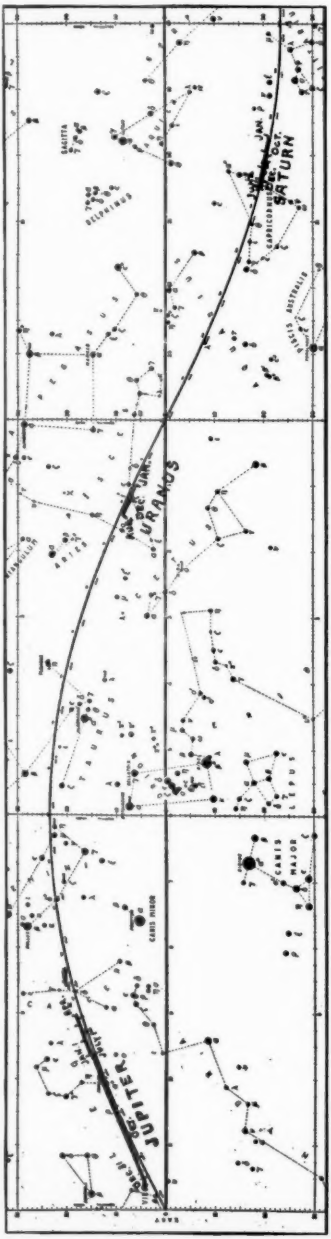


FIGURE 6. APPARENT PATHS OF JUPITER, SATURN, AND URANUS IN 1932.

stars in that region of the sky, Altair (α Aquilae $0^{M}.89$) and Antares (α Scorpii $1^{M}.22$).

URANUS.

Uranus will be in the constellation Pisces moving eastward until July 29, then westward until December 29. It will be in conjunction with the sun on April 9 and at opposition October 14. During December it will be less than one degree almost due east from the double star ξ Ceti, the components of which double the planet nearly equals in brightness. With a good telescope the planet shows a disc which distinguishes it from the stars. On April 29 at 19^{h}, G.C.T., Uranus will be 10′ due north of Mars, but observation of the two planets then will be difficult because of the nearness of the sun.

NEPTUNE.

Neptune's path is shown with that of Mars in Figure 5. It is short and difficult to plot, in the constellation Leo close to the ecliptic. The motion is slow, westward until May 16, then eastward until December 13, then westward. The planet will be at opposition on February 26 and in conjunction with the sun August 31. Neptune will be in conjunction with Mars, 1° 38′ south of the latter, on December 5 at 8^{h}, G.C.T. The disc of Neptune can be recognized only with large telescopes.

PLUTO.

Because of its great distance and its consequent long period, Pluto will change its position very little during the year. From an ephemeris published in the *Handbook of the B.A.A.* for 1932 its positions at the beginning and end of the year will be, respectively, R.A. $7^{h}\,32^{m}$, Decl. +22° 16′; R.A. $7^{h}\,38^{m}$, Decl. +22° 28′. It will be in the constellation Gemini, a short distance south of Castor and Pollux.

FIGURE 6. APPARENT PATHS OF JUPITER, SATURN, AND URANUS IN 1932.

Planet Notes for February, 1932

By CLIFFORD E. SMITH

The *Sun* will be moving in a northeasterly direction from the central part of Capricornus to the central part of Aquarius. The distance of the earth from the sun will be about 91.5 million miles at the beginning of the month and this distance will increase about 500,000 miles during the month. The position of the sun on the first and last days of the month will be, respectively: R.A. $20^{h}\,54^{m}$, Decl. −17° 30′; R.A. $22^{h}\,43^{m}$, Decl. −8° 7′.

The phenomena of the *Moon* will occur as follows:

New Moon	Feb.	6 at	9 A.M.	C.S.T.
First Quarter		14 "	12 M.	"
Full Moon		21 "	8 P.M.	"
Last Quarter		28 "	12 M.	"
Apogee		11 "	12 P.M.	"
Perigee		23 "	8 P.M.	"

Mercury will be moving from the eastern part of Sagittarius, across Capricornus, to the central part of Aquarius. Its distance from the earth will be about 125 million miles during this period, and its apparent diameter will be about 5 seconds of arc. Early in the month it will be a morning object rising about an hour before the sun, but during the latter part of the month its apparent position will be near that of the sun since superior conjunction will occur on the 26th. On

February 3 Mercury will be in conjunction with Saturn (Mercury 1°.3 south), and on February 5 Mercury will be in conjunction with the moon (Mercury 3° north). During the first part of the month the apparent brightness of Mercury will be about zero magnitude.

Venus will be a brilliant evening star of magnitude about —3.5 in Pisces, setting about 2½ hours after the sun. Its distance from the earth will be about 110 million miles, and its apparent diameter will be approximately 14 seconds of arc. On February 9 Venus will be in conjunction with the moon (Venus 1° south), and on February 27 it will be in conjunction with Uranus (Venus 0°.8 north).

Mars will be near the sun in apparent position. Conjunction with the sun will occur on February 1.

Jupiter will be a brilliant object of magnitude about —2 in western Leo, and it will be visible about all night long. Jupiter will be about 400 million miles from the earth and its apparent diameter will be about 42 seconds of arc. It will be in opposition on February 7, and it will be in conjunction with the moon on February 20 (Jupiter 3° south).

Saturn will be a morning object in western Capricornus of magnitude about +1, rising about an hour before the sun for places of low geographic latitude in the northern hemisphere.

Uranus will be an evening object in Pisces, and it will be on the meridian about $3^h\,30^m$ in the afternoon during the middle of the month. Its distance from the earth will be about 1900 million miles, and its apparent diameter will be somewhat greater than 3 seconds of arc. Conjunction with the moon will occur on February 11 (Uranus 3° south), and conjunction with Venus on February 27.

Neptune will be in central Leo, and its apparent motion will be retrograde. Its distance from the earth will be about 2700 million miles, and its apparent diameter will be about 2½ seconds of arc. Opposition will occur on February 26, and conjunction with the moon will occur on February 22 (Neptune 1° south).

OCCULTATIONS

OCCULTATIONS VISIBLE IN LONGITUDE +72° 30′, LATITUDE +42° 30′.
(Contributed by the office of the *American Ephemeris*.)

Date 1932	Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION a m	IMMERSION b m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION a m	EMERSION b m	EMERSION Angle E from N °
Feb. 14	47 Ari	5.8	3 54.9	0.0	—1.9	106	4 48.4	—0.2	—0.1	228
15	16 Tau	5.4	2 6.6	—1.3	—0.9	81	3 21.8	—0.8	—1.0	257
15	17 Tau	3.8	2 16.2	—0.9	—3.2	126	3 8.2	—1.4	+1.2	212
15	q Tau	4.3	2 33.4	—1.4	+0.7	43	3 31.5	—0.3	—2.7	297
15	20 Tau	4.1	2 44.4	—1.0	—0.7	74	3 55.0	—0.5	—1.4	267
15	22 Tau	6.5	3 6.6	—1.4	+1.0	35	3 54.9	+0.1	—3.1	307
15	21 Tau	5.8	3 8.0	—1.6	+2.1	24	3 46.0	+0.3	—4.2	318
18	49 Aur	5.1	2 28.2	—1.7	—1.3	112	3 48.1	—1.6	—1.0	270
20	γ Cnc	4.7	7 39.0	0.0	—2.1	143	8 32.0	—0.4	—1.4	272
22	NEPTUNE	7.7	9 44.1	—0.2	—1.9	140	10 37.9	—0.2	—1.6	284
23	80 Leo	6.4	5 40.2	—1.9	—0.3	103	6 44.6	—0.7	—2.0	337
25	50 Vir	6.2	4 54.0	—0.2	—1.4	166	5 47.4	—1.7	+0.9	270
26	43 H.Vir	5.5	11 20.2	—1.3	—1.3	112	12 29.9	—1.0	—1.7	298

OCCULTATIONS VISIBLE IN LONGITUDE +91°, LATITUDE +40°.

Date 1932	Star	Mag.	IMMERSION Greenwich C.T.	IMMERSION *a*	IMMERSION *b*	IMMERSION Angle E from N	EMERSION Greenwich C.T.	EMERSION *a*	EMERSION *b*	EMERSION Angle E from N
			h m	m	m	°	h m	m	m	°
Feb. 14	47 Ari	5.8	4 1.8	..	..	139	4 33.4	..	..	192
15	16 Tau	5.4	1 36.2	—2.1	—0.7	91	3 0.1	—1.7	+0.3	237
15	q Tau	4.3	2 0.9	—1.9	+0.7	58	3 21.4	—1.4	—1.5	272
15	17 Tau	3.8	2 4.1	..	..	153	2 22.3	..	..	176
15	20 Tau	4.1	2 19.1	—1.8	—0.9	89	3 40.5	—1.4	—0.2	244
15	21 Tau	5.8	2 34.3	—1.8	+1.0	48	3 45.1	—1.1	—2.2	286
15	22 Tau	6.5	2 36.0	—1.7	+0.5	56	3 51.5	—1.1	—1.8	278
18	49 Aur	5.1	1 55.6	—2.1	—1.6	127	3 10.6	—2.3	+1.3	243
19	c Gem	5.5	7 1.1	—1.9	—0.1	64	7 44.5	+0.5	—3.1	342
20	γ Cnc	4.7	7 54.6	..	..	195	8 10.4	..	..	224
22	NEPTUNE	7.7	9 46.2	0.0	—2.5	170	10 31.1	—1.1	—1.2	262
23	80 Leo	6.4	5 15.4	—1.0	—1.0	140	6 26.1	—1.6	—0.6	297
26	43 H.Vir	5.5	10 55.8	—1.5	—1.2	131	12 10.6	—1.6	—1.3	290
26	231 G.Vir	6.4	12 20.2	—1.0	—2.3	165	13 7.7	—1.5	—0.8	249
26	236 G.Vir	5.7	13 7.0	—1.1	—2.1	152	14 0.6	—0.9	—1.1	256
28	65 B.Sco	5.5	8 3.0	—2.4	+3.3	53	8 34.5	+0.9	—2.1	356

OCCULTATIONS VISIBLE IN LONGITUDE +120°, LATITUDE +36°.

Feb. 9	VENUS	—3.5	19 10.7	—1.8	+2.0	81	20 24.8	—0.7	+3.0	195
14	ε Ari	4.6	4 40.8	..	..	8	5 15.8	..	..	315
15	16 Tau	5.4	0 29.3	—1.8	+1.7	67	1 58.8	—2.0	+1.5	238
15	17 Tau	3.8	0 31.2	—3.2	—0.5	110	1 32.2	—0.7	+4.1	195
15	q Tau	4.3	1 0.4	—1.4	+2.7	41	2 24.8	—2.6	+0.1	266
15	20 Tau	4.1	1 12.4	—2.3	+1.1	77	2 43.4	—2.0	+1.6	233
15	21 Tau	5.8	1 33.1	—1.6	+2.6	40	2 56.8	—2.6	—0.4	270
15	22 Tau	6.5	1 33.8	—1.8	+2.2	49	3 3.0	—2.5	0.0	262
17	406 B.Tau	5.6	9 49.8	+1.2	—3.2	158	10 18.6	—0.9	+0.6	219
18	49 Aur	5.1	1 0.2	—1.5	+0.2	114	2 7.2	—1.1	+2.3	237
18	54 Aur	5.8	3 25.9	—2.1	+1.7	69	4 46.1	—2.2	—1.5	299
19	c Gem	5.5	6 13.2	—1.7	—1.6	124	7 33.5	—1.9	—1.1	279
24	162 B.Vir	6.2	10 12.6	—2.6	0.0	89	11 9.1	—0.4	—2.5	353
25	i Vir	5.7	14 12.1	—1.2	—1.5	120	15 19.7	—0.8	—1.8	299

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phenomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standard Time, six hours, etc.

Variable Stars

Monthly Report of the American Association of Variable Star Observers for November, 1931

The present report is the largest for any one month for several years past, with over 3000 observations of 400 variables as made by 49 different observers. We welcome initial contributions from Mr. Walter Houston of Madison, Wiscon-

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

Sept. 0 = J.D. 2426585; Oct. 0 = J.D. 2426615; Nov. 0 = J.D. 2426646.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
V Scl			T Cas			T Scl			RV Cas			S Cas			X Cas		
000339			001755			*002438a*			004746a			011272			014958		
596[	13.3	Bl	625	10.6	Pl	594	9.5	En	632	13.6	Pt	630	12.7	B	624	10.7	Jo
S Scl			625	10.6	Sr	T Phe			635	13.5	Ch	632	12.7	B	626	11.1	Bn
001032			626	10.3	Th	*002546*			W Cas			649	11.3	B	627	10.6	Mp
594	9.4	En	628	9.4	Jo	594[	13.0	En	004958			653	11.4	Wy	628	10.7	Jo
596	9.1	Bl	630	9.7	Hu	596[	13.6	Bl	616	12.0	Jo	U Psc			631	10.5	Pt
X And			631	9.7	Hu	α Cas			618	11.8	Jo	011712			635	11.1	Bn
001046			631	9.2	Pt	003456			620	11.5	Jo	618	11.4	L	637	10.5	Jo
648	13.6	Br	631	10.0	Th	617	2.4	Ko	624	11.2	Jo	631	11.6	Pt	638	10.0	B
653	13.9	Bw	633	9.1	Jo	621	2.4	Ko	625	11.7	Wy	632	11.8	L	647	11.1	Bn
T Cet			634	9.0	Mp	624	2.4	Ko	628	11.3	Jo	646	13.2	L	655	11.1	Al
001620			635	9.6	Mn	633	2.2	Ko	633	11.3	Jo	RZ Per			659	11.1	Bn
623	5.8	L	637	9.0	Jo	634	2.3	Ko	634	11.2	Bo	012350			U Per		
T And			638	9.2	B	639	2.4	Ko	635	11.1	Ch	624	9.9	Br	015254		
001726			644	9.5	Mn	646	2.4	Ko	637	11.2	Jo	625	10.1	L	616	8.7	Jo
594	11.4	Ch	646	8.9	L	U Cas			639	11.0	Bo	627	10.4	Mp	618	8.5	Jo
615	9.8	Th	646	9.0	Jo	004047			646	11.1	Bo	632	10.1	B	618	8.7	Ry
616	9.8	Jo	648	9.3	Hu	618	11.6	L	646	10.8	Jo	635	10.2	L	620	8.6	Jo
618	9.7	Jo	648	9.0	Mc	619	10.6	Jo	649	11.2	Bo	653	10.5	Me	622	8.6	Ry
618	9.8	Th	649	8.8	Mc	624	10.0	Jo	649	11.0	B	655	10.4	Al	627	8.6	Ry
620	9.6	Jo	649	9.6	Hu	627	9.8	Jo	653	11.0	Bw	R Psc			628	8.7	Jo
622	9.6	Th	650	8.8	Mc	630	9.8	Hu	655	11.0	Bo	012502			631	8.5	Pt
624	9.5	Th	654	9.2	Me	631	10.1	Hu	656	10.8	Me	616	8.5	Ah	633	8.7	Ry
624	9.5	Jo	655	8.2	Al	631	10.2	Me	U Tuc			620	8.3	Ah	633	8.6	Jo
626	9.5	Th	659	8.9	Mc	631	9.9	Pt	*005475*			621	8.0	Jo	634	8.7	Bo
628	9.5	Jo	R And			632	9.7	L	594[	12.9	En	624	8.5	Ah	635	8.7	Ry
630	9.6	Hu	001838			633	9.7	Jo	Z Cet			626	8.6	Ah	639	8.5	Bo
631	9.5	Hu	625	13.3	B	634	9.5	Me	*010102*			627	8.5	Ah	640	8.5	Ry
631	9.1	Pt	630	12.5	Hu	635	9.7	Ch	618	12.9	L	628	8.6	Ah	645	8.6	B
631	9.4	Th	631	12.8	Hu	637	9.4	Jo	624	13.1	Br	630	8.4	Ah	646	8.9	Bo
632	9.5	Hu	631	12.5	Pt	638	9.4	B	631	12.5	Pt	631	8.4	Ah	648	9.2	Mc
633	9.8	Hu	635	12.8	Ch	645	9.3	Sf	632	11.4	L	631	8.2	Pt	649	9.0	Bo
633	9.2	Jo	646	11.0	Wd	646	9.3	Me	644	11.9	B	632	8.5	Ah	649	8.4	Me
637	8.7	Jo	649	11.4	Pc	648	9.3	Hu	658	11.1	Me	633	8.0	Jo	650	9.0	Mc
638	8.8	B	655	11.5	Gy	648	9.6	Bw	U And			636	8.2	Ah	653	8.2	Wy
648	8.6	Br	658	11.0	Hu	649	9.3	Hu	010940			637	8.1	Ah	655	8.9	Bo
648	8.8	Hu	S Tuc			650	9.4	Sf	625	14.3	L	658	8.4	Me	655	8.5	Al
649	8.6	Md	*001862*			654	9.3	Me	625	13.9	B	RU And			659	8.5	Mc
653	8.3	Me	594[	13.2	En	656	9.2	Me	632	14.0	L	013238			S Ari		
655	8.5	Gy	596[	13.5	Bl	656	9.2	Hu	635	12.8	Ch	594	11.3	Ch	015912		
658	8.0	Hu	S Cet			656	9.6	Md	644	13.2	B	621	11.5	Jo	626	14.8	L
T Cas			*001909*			658	9.2	Hu	649	13.2	Pc	624	10.9	Br	R Ari		
001755			594	10.0	Ch	659	9.3	Sf	658	12.8	Hu	625	10.1	L	021024		
594	11.0	Ch	617	8.7	Jo	659	9.3	Me	UZ And			625	10.6	B	618	12.5	L
603	10.9	Sr	619	8.5	Jo	— Cas			011041			631	10.5	Pt	624	13.0	Br
616	10.4	Mn	621	8.2	Jo	004047b			625	10.0	B	635	10.6	L	631	12.7	Pt
616	10.5	Jo	624	8.2	Jo	631	10.5	Pt	625	10.4	L	650	11.2	B	632	12.9	L
618	10.4	Jo	624	8.4	Br	RW And			632	10.2	L	650	11.3	Ma	645	13.0	B
618	11.0	Th	625	8.5	L	004132			635	11.0	Ch	655	11.3	Al	W And		
620	10.3	Jo	627	8.5	Mp	624[	13.9	Br	650	10.2	B	Y And			021143a		
621	10.7	Sj	628	8.3	Jo	635[	13.2	Ch	653	11.0	Bw	013338			620	10.5	Ah
621	10.6	Sr	630	8.4	Hu	V And			658	10.7	Me	624[	14.4	Br	621	10.5	Ch
622	10.9	Th	631	8.4	Hu	004435			S Psc			631	14.2	Pt	623	10.6	Ah
624	9.4	Jo	631	8.2	Pt	625	13.8	L	011208			650[	12.6	Ma	624	10.9	Ah
624	10.2	Mn	646	8.7	L	632	14.4	L	625	11.9	L	X Cas			624	10.9	Br
625	9.0	Mp	646	8.7	Sf	RR And			635	13.0	L	014958			627	11.1	Ah
625	10.5	L	649	8.7	Me	004533			651	13.0	B	616	11.5	Jo	631	10.8	Pt
625	10.1	Wy	652	8.7	Sf	635	11.0	Ch				618	11.0	Jo	645	11.2	B
			659	8.8	Sf	644	9.9	B				620	10.8	Jo	654	11.9	Bw

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
W AND	S PER	R TRI	U ARI	NOV PER	V TAU
021143a	021558	023133	030514	032443	044617
655 12.1 Gy	617 9.7 Sz	624 9.8 Jo	630 12.7 Ch	631 13.5 Pt	621 7.9 Jo
T PER	618 8.5 Jo	626 10.2 Ah	X CET	T FOR	650 9.7 Ie
021258	620 9.7 Ah	627 10.3 Ah	*031401*	*032528*	653 10.2 Wy
616 8.7 Jo	621 8.5 Jo	630 10.5 Ah	617 9.6 L	617 9.0 L	R ORI
618 8.5 Jo	623 9.7 Ah	630 10.5 Ch	619 9.8 Jo	632 8.6 L	045307
620 8.7 Ah	624 9.6 Ah	631 9.6 Pt	621 9.3 Jo	R TAU	626 11.3 L
621 8.5 Jo	624 8.6 Jo	631 10.5 Ah	631 9.5 Pt	042209	644 10.0 L
623 8.8 Ah	624 10.1 Sz	633 10.2 Jo	632 9.5 L	631 11.9 Pt	R LEP
624 8.7 Ah	631 10.2 Pt	646 11.5 Sf	650 8.9 Sf	652 12.5 B	*045514*
631 8.6 Pt	632 9.4 B	646 11.0 Wd	653 8.3 Wy	W TAU	617 7.5 L
634 8.5 Jo	634 9.6 Ah	649 11.3 B	659 8.9 Sf	042215	618 7.6 Jo
634 8.8 Ah	634 9.9 Bo	649 11.3 Wd	Y PER	591 10.4 Cy	621 7.5 Jo
634 8.8 Bo	639 10.0 Bo	652 11.4 Sf	032043	616 10.9 Jo	631 7.2 Pt
639 8.9 Bo	646 10.1 Bo	655 11.5 Gy	617 8.6 Jo	619 10.8 Jo	632 7.6 L
646 8.8 Bo	649 10.2 Bo	659 11.6 Sf	620 9.0 Jo	621 10.0 Jo	633 7.2 Jo
649 8.9 Bo	650 9.2 B	T ARI	620 9.8 Ah	624 9.7 Jo	634 6.5 Si
655 8.8 Bo	653 10.2 Wy	024217	621 9.8 Ch	625 10.9 L	636 7.3 Jo
Z CEP	655 10.0 Bo	619 8.3 Jo	622 9.9 Ah	631 10.4 Pt	644 7.2 L
021281	R CET	624 8.4 Jo	623 9.9 Ah	634 10.4 Jo	V ORI
627[13.0 Mp	*022000*	628 8.5 Jo	624 9.8 Ah	634 10.4 Me	050003
o CET	625 13.2 L	631 8.8 Me	624 9.1 Jo	635 10.9 L	626 13.2 L
021403	635 12.3 L	633 8.6 Jo	626 9.9 Ah	650 10.6 Cy	631 12.6 Pt
591 7.8 Cy	650 10.3 Sf	637 8.8 Jo	627 10.0 Ah	653 10.2 Wy	T LEP
599 7.2 Si	653 10.0 Bg	646 9.0 Jo	628 9.2 Jo	S TAU	*050022*
601 7.3 Si	659 9.3 Sf	646 9.2 Me	630 10.1 Ah	042309	631 11.3 Pt
617 7.6 Jo	RR PER	653 9.3 Me	631 10.1 Ah	631 12.1 Pt	633 10.6 Jo
619 7.6 Jo	022150	W PER	631 9.3 Pt	T CAM	636 10.4 Jo
620 8.7 Ah	621 10.0 Ch	024356	634 10.3 Ah	043065	R AUR
621 8.2 Jo	625 10.0 L	590 9.3 Cy	634 9.7 Bo	616 8.0 Jo	050953
621 8.5 Ch	631 9.4 Pt	616 9.7 Jo	637 9.3 Jo	618 7.8 Jo	616 8.6 Jo
624 8.3 Jo	635 9.3 L	618 10.5 Ry	639 9.8 Bo	620 7.6 Jo	619 8.5 Jo
624 8.7 Ah	650 10.2 B	620 9.8 Jo	646 10.0 Bo	624 7.8 Jo	620 8.6 Ah
624 8.3 Si	654 10.5 Bw	622 10.5 Ry	646 9.8 Jo	625 8.1 L	621 8.2 Jo
625 8.5 L	658 11.0 Me	624 9.9 Jo	648 10.1 Mc	631 8.2 Pt	622 8.7 Ah
626 8.7 Ah	U CET	627 10.6 Ry	649 10.1 Bo	633 7.9 Jo	623 8.6 Ah
627 8.8 Ah	*022813*	631 10.4 Pt	650 10.0 Mc	634 8.2 Bo	623 8.6 Mn
630 8.7 Ah	617 10.1 L	632 10.4 B	651 10.3 Me	635 8.4 L	624 8.2 Jo
631 8.8 Ah	631 9.5 Pt	633 10.5 Ry	653 10.2 Wy	639 8.3 Bo	624 8.5 Ah
631 8.4 Pt	632 10.0 L	633 10.3 Jo	655 10.2 Bo	646 8.5 Bo	626 8.7 Ah
632 8.8 Ah	655 7.2 Gy	635 10.6 Ry	659 10.0 Mc	646 8.4 Jo	627 8.6 Ah
633 8.6 We	RR CEP	637 10.5 Jo	R PER	649 8.6 Bo	628 8.5 Ah
634 8.6 Jo	022980	640 10.6 Ry	032335	650 8.8 Pc	630 8.4 Ah
634 9.1 Bo	627[12.2 Mp	646 11.5 Jo	616 9.4 Jo	653 8.8 Wy	631 8.2 Ah
634 8.5 Si	650 13.6 Pc	648 9.9 Mc	618 9.1 L	655 8.8 Bo	631 8.1 Pt
639 8.9 Bo	659[12.5 Ie	649 10.6 B	619 9.3 Jo	RX TAU	632 8.3 Ah
644 8.6 L	R TRI	650 10.7 Cy	621 9.2 Jo	043208	633 8.4 Mn
646 9.0 Bo	023133	650 10.2 Mc	624 8.8 Br	625 11.9 L	634 8.1 Jo
646 8.9 Wd	589 8.4 Si	651 10.6 Mc	630 8.8 Ch	652 12.7 B	634 8.3 Ch
649 8.9 Bo	594 9.3 Ch	653 11.1 Wy	631 9.0 Pt	654 12.8 Bw	636 8.2 Ah
650 9.0 Cy	601 8.2 Si	654 11.1 Bw	632 8.5 L	X CAM	637 8.1 Ah
650 9.2 Sf	602 8.3 Si	659 9.5 Mc	637 8.7 Jo	043274	637 8.0 Jo
655 9.0 Gy	616 9.5 Jo	R HOR	646 8.6 Jo	625 12.2 L	641 8.2 Ja
655 9.0 Bo	619 9.5 Jo	*025050*	650 8.9 Pc	631 12.0 Pt	645 7.7 Mn
659 9.2 HS	620 9.8 Ah	602 11.0 En	650 8.9 B	635 11.4 L	646 8.0 Wd
659 9.2 Sf	622 9.9 Ah	U ARI	653 9.0 Wy	650 10.3 Pc	646 7.6 Jo
S PER	623 9.9 Ah	030514	658 8.7 Me	653 9.5 Wy	653 7.3 Wy
021558	624 10.1 Ah	624 12.5 Br		658 9.2 Me	659 7.8 Al
616 8.7 Jo	624 8.8 Si	625 12.6 L			

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
NOV TAU	AN ORI	SU TAU	U ORI	U LYN	R GEM
051316	*053005t*	054319	054920a	063159	070122a
626[13.9 L	650 11.3 Ma	652 9.6 Pt	653 6.0 Co	624 14.0 Br	636 10.4 Jo
S AUR	650 11.5 Me	653 9.6 Pt	653 6.0 Eb	R MON	650 8.6 Wd
052034	659 11.4 Ma	654 9.6 Pt	659 6.2 Mc	063308	651 10.8 Ch
616 8.7 Jo	S CAM	655 9.7 Pt	V CAM	631 12.2 Pt	652 8.4 Wd
620 8.6 Jo	053068	659 9.8 Ma	054974	S LYN	Z GEM
624 8.7 Jo	616 8.5 Jo	659 9.9 Ie	631 9.8 Pt	063558	070122b
631 8.2 Pt	618 8.5 Jo	660 9.5 Lg	632 9.6 L	622 11.5 Ry	631 12.5 Pt
634 9.3 Ch	620 8.4 Jo	660 9.7 Wy	650 10.1 Pt	627 11.7 Ry	TW GEM
634 8.7 Jo	624 8.0 Jo	Z TAU	653 10.9 Pt	628 12.6 L	070122c
646 10.0 Bo	631 8.4 Pt	054615a	Z AUR	631 12.5 Pt	631 7.8 Pt
649 9.9 Bo	633 8.1 Jo	626 11.3 L	055353	634 12.9 Ry	R CMI
650 9.8 Mc	646 8.2 Jo	644 11.1 L	621 9.9 Jo	640 13.1 Ry	070310
653 9.6 Wy	650 8.5 Pc	659 12.2 Ma	630 10.0 Pt	X GEM	628 9.2 L
655 10.0 Bo	651 8.6 Me	RU TAU	631 10.1 Pt	064030	631 9.8 Pt
659 10.0 Mc	660 8.5 Wy	054615c	632 10.0 Pt	650 9.8 Bn	631 9.8 Ch
W AUR	RR TAU	628 11.6 L	633 10.1 Pt	655 9.9 Bn	633 9.0 Jo
052036	053326	644 11.6 L	634 10.0 Pt	659 10.1 Bn	644 9.8 L
626 14.0 L	617 10.8 L	659 11.6 Ma	635 10.1 Pt	664 10.4 Bw	RR MON
631 13.9 Pt	626 12.1 L	α ORI	636 10.0 Pt	Y MON	071201
634 13.6 Ch	628 12.1 L	054907	639 10.2 Pt	065111	628[14.2 L
S ORI	632 11.7 L	579 0.9 Si	648 10.4 Pt	628 12.2 L	630[13.4 Br
052404	633 12.7 L	593 0.9 Si	648 10.2 Mc	630 12.1 Br	V GEM
631 9.3 Pt	635 12.8 L	598 0.9 Si	649 10.4 Pt	631 11.7 Ch	071713
634 10.0 Ch	644 12.3 L	599 0.9 Si	650 10.2 Pt	631 12.3 Pt	617 13.0 L
T ORI	RU AUR	601 0.9 Si	650 10.2 Mc	X MON	630 12.4 Br
053005a	053337	617 0.9 Si	651 10.2 Pt	*065208*	632 11.9 L
611 10.8 Ch	624 12.8 Br	618 0.9 Si	652 10.7 Pt	617 8.3 L	633 11.0 Jo
617 10.4 L	631 11.3 Pt	620 1.0 Si	652 10.6 Sf	632 8.5 L	653 11.4 Pt
618 10.4 L	634 11.2 Ch	622 0.9 Si	653 10.6 Pt	644 8.5 L	664 11.1 Bw
620 9.7 Jo	650 10.5 Pc	624 1.0 Si	654 10.8 Pt	R LYN	S CMI
626 10.2 L	650 10.3 Pt	633 0.8 Si	655 10.8 Pt	065355	072708
628 10.3 L	653 10.2 Pt	634 0.8 Si	658 10.6 Me	620 7.8 Ah	631 8.5 Ch
631 10.5 Pt	654 10.2 Bw	635 0.8 Si	659 9.9 Mc	623 7.9 Ah	631 8.4 Pt
632 10.5 Pt	U AUR	639 0.4 Ko	659 10.6 Sf	624 8.0 Ah	633 8.2 Jo
632 10.2 L	053531	646 0.5 Ko	R OCT	626 8.1 Ah	636 8.5 Jo
633 10.2 L	618 12.7 L	646 0.9 Si	*055686*	627 8.0 Ah	T CMI
633 10.6 Pt	624 12.8 Br	648 0.4 Mc	592 8.4 Bl	628 8.1 Ah	072811
633 9.8 Jo	631 13.2 Pt	650 0.3 Mc	603 8.5 Bl	628 7.4 L	630 13.3 Br
634 10.0 Ch	635 13.5 L	652 0.2 Mc	X AUR	630 8.1 Ah	631 13.0 Pt
634 9.7 Me	SU TAU	U ORI	060450	631 8.1 Ah	S VOL
635 10.1 L	054319	054920a	624 11.4 Br	631 7.7 Pt	*073173*
636 10.5 Pt	611 10.3 Ch	611 9.8 Ch	628 11.8 L	632 8.0 Ah	592 12.0 Bl
636 10.0 Jo	617 9.6 L	620 9.1 Ah	631 11.6 Pt	636 8.2 Ah	U CMI
640 10.0 Ma	626 9.5 L	624 8.8 Ah	634 11.7 Ch	637 8.2 Ah	073508
644 10.1 Ma	630 9.5 Br	624 8.8 Jo	650 12.5 Pc	V CMI	617 9.3 L
644 10.2 L	631 9.6 Pt	626 8.6 Ah	V AUR	070109	630 9.9 Br
650 10.2 Ma	632 9.6 Pt	627 8.6 Ah	061647	628 7.8 L	631 9.8 Pt
650 10.6 Me	632 9.6 L	630 8.1 Ah	628 11.6 L	630 8.2 Br	632 9.4 L
653 10.4 Pt	633 9.6 Pt	631 8.0 Ah	634 11.8 Ch	631 8.4 Ch	644 9.6 L
654 11.0 Pt	634 9.6 Ch	631 8.3 Pt	659 11.5 Bg	631 8.0 Pt	S GEM
654 11.3 Bw	636 9.6 Pt	632 7.7 Ah	V MON	644 8.2 L	073723
655 11.0 Pt	639 9.7 Pt	633 8.7 Jo	*061702*	R GEM	626 10.1 Th
658 9.7 Me	644 9.6 L	634 7.4 Me	631 9.8 Pt	070122a	630 11.1 Br
659 10.0 Ma	648 9.6 Pt	636 7.3 Ah	AG AUR	624 12.0 Ah	631 11.3 Pt
AN ORI	649 9.6 Pt	637 7.3 Ah	062047	627 11.8 Ah	633 10.6 Jo
053005t	650 9.6 Pt	648 6.6 Mc	617 9.6 L	630 11.7 Ah	634 11.5 Ch
640 10.8 Ma	650 9.5 Pc	650 6.5 Mc	628 9.1 L	631 11.2 Pt	636 11.0 Jo
644 11.4 Ma	650 9.8 Ma	650 6.5 Wd	644 9.1 L	633 10.5 Jo	

Variable Star Observations Received During November, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T Gem	T Hya	RV Car	S Leo	T UMa	V CVn
074323	*085008*	*095563*	110506	123160	131546
621 8.7 Ah	628 9.1 L	592[13.1 Bl	632 13.7 L	636 7.4 Ah	643 6.9 GD
624 8.9 Ah	631 8.9 Pt	S Car	RY Car	637 7.6 Ah	R Hya
627 9.1 Ah	631 9.2 Ch	*100661*	*111561*	637 7.7 Jo	*132422*
630 9.1 Ah	644 7.8 L	586 6.5 En	592 11.8 Bl	640 8.0 Wd	592 9.6 Bl
630 8.8 Br	T Cnc	592 6.3 Bl	601 12.5 Bl	644 7.5 Mn	603 9.6 Bl
631 8.9 Pt	085120	603 6.9 Bl	RS Cen	646 7.8 Wd	RV Cen
631 9.2 Ah	631 9.0 Ch	U UMa	*111661*	653 7.4 Wd	*133155*
632 9.2 Ah	631 7.8 Pt	100860	592[13.1 Bl	655 7.7 Gy	586 8.6 En
633 8.6 Jo	V UMa	616 6.5 Mn	601[13.1 Bl	RS UMa	592 8.7 Bl
634 9.1 Ch	090151	624 6.6 Mn	X Cen	123459	595 8.6 En
636 8.8 Jo	617 10.6 L	633 6.5 Mn	*114441*	594 10.0 Ch	603 8.0 Bl
659 10.2 Bw	632 10.6 L	645 6.5 Mn	592 9.5 Bl	616 11.2 Jo	614 8.6 En
R Cnc	650 10.1 Mc	Z Car	603 9.6 Bl	617 10.9 Mn	T UMi
081112	659 10.3 Mc	*101058a*	AD Cen	619 11.7 Jo	133273
609 10.0 Ch	W Cnc	592[12.3 Bl	*114858*	620 11.6 Ry	623 13.6 L
631 10.6 Pt	090425	W Vel	586 9.2 En	622 11.8 Ry	T Cen
633 10.5 Jo	617 10.8 L	*101153*	W Cen	624 11.8 Jo	*133633*
636 10.6 Jo	632 11.1 L	592 10.5 Bl	*115058*	626 12.2 Ry	586 6.4 En
V Cnc	RX UMa	603[11.1 Bl	592 12.5 Bl	626 12.3 Bn	592 6.1 Bl
081617	090567	R UMa	595 12.2 En	630 13.0 Pt	595 6.0 En
618 7.6 L	617 10.4 L	103769	601 12.0 Bl	633 12.5 Jo	603 6.8 Bl
621 7.7 Ah	632 10.3 L	616 8.7 Jo	SU Vir	633 12.8 Ry	RT Cen
624 8.0 Ah	RW Car	617 9.2 Mn	120012	647 13.5 Bn	*134236*
626 8.0 Ah	*091868*	617 8.5 Sz	533 11.9 L	659 13.6 Bn	586 12.9 En
627 8.1 Ah	592[12.8 Bl	619 8.8 Jo	T Vir	S UMa	592 13.2 Bl
630 8.1 Ah	R Car	619 8.4 We	*120905*	123961	595 12.4 En
630 8.0 Br	*092062*	620 9.2 Ah	645[11.0 L	594 8.5 Ch	R CVn
631 8.1 Ah	592 5.5 Bl	623 9.2 Ah	SS Vir	616 9.5 Jo	134440
631 7.8 Ch	603 6.0 Bl	624 9.3 Ah	*122001*	617 10.3 Sz	630 11.0 Pt
631 7.8 Pt	X Hya	624 8.9 Jo	635 6.3 L	617 9.6 Mn	RX Cen
632 7.9 L	*093014*	624 8.6 Sz	U Cen	619 10.1 Jo	*134536*
632 8.0 Ah	631 8.4 Ch	624 9.5 Mn	*122854*	620 9.4 Ah	586[13.1 En
655 8.7 Gy	631 8.2 Pt	626 9.4 Ah	586 11.1 En	623 9.6 Ah	592[13.1 Bl
RT Hya	Y Dra	627 9.5 Ah	592 12.2 Bl	624 9.7 Ah	595[13.1 En
082405	093178	627 9.2 We	595 11.5 En	624 9.9 Mn	T Aps
618 8.4 L	617 10.6 L	630 9.7 Ah	T UMa	624 10.0 Jo	*134677*
631 8.6 Pt	630 11.2 Br	631 10.0 Ch	123160	626 9.9 Ah	586[12.7 En
632 8.5 L	630 10.3 Br	631 9.5 Pt	616 8.6 Jo	627 10.2 Ah	592[13.2 Bl
644 8.8 L	631 10.6 Ch	632 9.7 Ah	617 8.5 Mn	630 10.6 Ah	RU Hya
R Cha	631 10.5 Pt	633 10.0 Mn	619 8.1 Jo	630 10.6 Pt	*140528*
082476	631 10.5 Ah	633 9.2 Jo	620 8.4 Ah	631 10.5 Ah	586 8.4 En
592 10.9 Bl	632 11.0 L	636 9.5 Jo	621 8.1 Ah	632 10.4 Ah	592 8.7 Bl
600 9.8 Bl	632 10.3 Ah	640 10.0 Wd	621 8.2 Ch	633 10.0 Mn	595 9.0 En
U Cnc	655 11.4 Gy	645 10.6 Mn	621 7.8 Jo	633 10.6 Jo	600 9.0 Bl
083019	R Leo	649 11.0 Wd	623 8.2 Ah	637 10.7 Jo	614 10.1 En
628 10.5 L	094211	650 9.8 Mc	624 7.9 Ah	644 10.4 Mn	R Cen
630 11.3 Br	627 9.9 Ah	652 10.9 Wd	624 7.8 Jo	648 10.6 Mc	*140959*
631 11.0 Ch	631 10.2 Ch	655 10.9 Gy	624 8.1 Mn	650 10.8 Mc	586 10.0 En
X UMa	631 10.2 Pt	658 9.5 Mc	626 8.0 Ah	U Oct	592 9.3 Bl
083350	633 10.0 Jo	V Hya	627 7.9 Ah	*131283*	595 10.3 En
630[13.5 Br	634 9.9 Si	*104620*	628 8.0 Ah	592 13.0 Bl	600 9.7 Bl
631 14.0 Pt	634 10.0 Me	644 6.5 L	630 8.1 Ah	614 12.9 En	602 10.3 En
S Hya	636 10.2 Jo	W Leo	630 7.6 Pt	V CVn	614 10.3 En
084803	V Leo	104814	631 7.8 Ah	131546	U UMi
609 11.3 Ch	095421	618 10.6 L	632 7.9 Ah	618 7.8 Th	141567
631 11.7 Pt	630 12.2 Br	635 11.1 L	633 7.8 Mn	624 7.5 Th	616 10.8 Jo
	631 12.0 Pt		633 7.7 Jo	631 7.5 Th	619 11.0 Jo
			634 7.8 Ah	631 7.0 GD	620 11.1 Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
U UMi	R Boo	S CrB	T Nor	R CrB	V CrB
141567	143227	151731	*153654*	154428	154639
623 11.2 Ah	626 7.5 Ah	631 6.9 Ah	595 9.6 En	634 5.7 Ko	630 7.9 Ah
624 11.2 Ah	627 7.6 Ah	631 7.0 Pt	614 7.7 En	634 5.8 Mn	631 7.9 Ah
624 11.5 Jo	630 7.5 Ah	631 6.6 Th	Z Lib	634 5.9 Me	631 7.2 Pt
627 11.5 Ah	630 6.8 Pt	632 6.7 Th	*154020*	636 6.1 Pt	631 8.3 Th
628 11.5 Jo	632 7.1 Ah	632 7.0 Ah	593[12.7 Bl	637 6.1 Ah	632 7.9 Ah
630 11.5 Ah	634 7.0 Jo	634 7.0 Ah	R CrB	639 6.1 Be	633 7.5 Jo
630 12.0 Pt	637 6.6 Jo	634 7.2 Mn	154428	640 6.0 Me	634 8.3 Th
631 11.3 Ah	637 6.9 Ah	634 6.7 Th	571 6.1 Cy	640 6.0 Wd	636 8.3 Th
634 11.6 Jo	S Lup	636 6.8 Th	580 6.3 Si	640 6.1 Pt	637 8.0 Ah
S Boo	*144646a*	637 6.9 Ah	582 6.2 Si	643 6.1 Pt	637 7.6 Jo
141954	586[12.1 En	637 6.8 Ko	585 6.0 Cy	643 5.9 GD	648 9.2 Mc
614 10.9 Ch	614[12.1 En	644 7.1 Mn	586 5.5 Cy	644 6.0 Mn	650 9.1 Mc
616 10.6 Jo	U Boo	645 7.1 Sf	588 5.6 Cy	644 6.2 We	R Lup
617 10.9 We	144918	RS Lib	588 6.0 Si	645 6.0 L	*154736*
618 10.9 Th	588 12.0 Cy	*151822*	590 5.9 Cy	646 6.0 Wd	595[12.0 En
618 11.0 Jo	599 12.0 Cy	586 11.6 En	594 6.2 Ch	646 6.0 Me	Z CrB
620 11.2 Jo	Y Lup	592 11.7 Bl	594 6.0 Si	648 5.8 Mc	155229
625 11.7 Jo	*145254*	595 11.7 En	599 5.9 Cy	648 6.1 Pt	623[13.6 L
625 12.2 L	586[13.7 En	603 11.7 Bl	616 6.0 Be	649 6.0 Mg	645 13.2 L
630 12.3 Pt	592[13.7 Bl	614 11.4 En	616 5.8 Mn	649 6.0 Me	RZ Sco
634 12.3 Jo	614[13.7 En	R Nor	616 6.0 Jo	649 6.0 Wd	*155823*
V Boo	S Aps	*152849*	616 6.0 Si	649 6.2 Pt	586 9.0 En
142539a	*145971*	586[12.8 En	617 6.1 Ko	650 6.1 Pt	595 8.9 En
588 8.7 Cy	586 11.2 En	592 13.3 Bl	617 6.0 L	650 5.9 Mc	612 8.6 En
594 8.9 Ch	592 11.6 Bl	614[12.8 En	618 6.0 Jo	650 5.6 Cy	Z Sco
616 8.9 Mn	594 11.4 En	X Lib	618 6.1 Si	651 6.0 Me	*160021*
616 8.5 Jo	595 11.7 Bl	*153020*	619 6.0 Be	651 6.1 Pt	588 9.3 En
618 8.5 Jo	600 11.6 Bl	592 13.0 Bl	620 6.1 Ah	653 6.1 Pt	593 9.0 Bl
620 8.6 Jo	602 11.2 En	W Lib	620 6.0 Jo	658 6.0 Me	595 9.5 En
620 9.0 Ah	603 11.5 Bl	*153215*	621 5.7 Ko	659 6.1 Gy	600 9.0 Bl
623 9.0 Ah	614 11.0 En	592[13.0 Bl	621 6.0 L	V CrB	614 9.7 En
624 8.9 Ah	S Ser	S UMi	621 6.1 Si	154536	R Her
625 8.8 Jo	151714	153378	623 6.1 Ah	621 10.6 L	160118
626 9.0 Ah	615 9.0 Th	594 8.9 Ch	623 6.0 Be	627 11.2 B	625 10.1 Jo
627 9.0 Ah	623 9.0 L	616 9.0 Jo	623 6.1 L	631 10.4 Pt	627 10.0 Jo
627 9.2 Mn	624 9.3 Th	619 9.1 Ko	624 6.1 Ah	645 12.0 L	631 10.1 Pt
629 9.1 Cy	632 9.3 Th	620 9.5 Ah	624 6.0 Si	R Ser	633 9.8 Jo
630 9.1 Ah	645 9.2 L	620 9.0 Jo	625 6.0 Jo	154615	637 9.6 Jo
630 9.0 Pt	S CrB	623 9.6 Ah	626 6.1 Ah	621 10.2 Ch	U Ser
631 9.1 Ah	151731	624 9.6 Ah	626 6.0 L	631 10.0 Pt	160210
632 9.2 Ah	594 9.0 Ch	624 9.5 Jo	627 6.0 Ah	V CrB	588 9.6 Cy
634 9.4 Mn	616 7.2 Mn	626 9.6 Ah	627 6.0 We	154639	599 9.3 Cy
634 8.8 Jo	618 6.8 Th	627 9.7 Ah	627 5.9 Cy	588 7.3 Cy	625 8.8 Wy
637 9.0 Jo	619 6.9 Ko	630 9.8 Ah	627 6.0 Ko	599 8.1 Cy	631 9.0 Pt
637 9.3 Ah	619 6.9 Jo	631 9.7 Ah	627 5.6 Mn	615 8.0 Th	X Sco
645 9.6 Sf	620 7.0 Ah	631 10.1 Pt	629 6.1 Be	618 7.9 Th	*160221a*
645 9.9 Mn	621 6.7 Jo	637 10.2 Ko	629 6.1 Pt	618 7.4 Jo	593[12.8 Bl
650 10.5 Mc	621 6.8 Th	645 10.5 Sf	630 6.1 Pt	619 7.0 Mp	SX Her
R Boo	623 6.8 Ah	650 10.5 Sf	630 6.0 Ah	620 7.5 Jo	160325
143227	624 6.9 Ah	651 10.5 Me	630 6.0 Mg	620 8.5 Ah	619 8.2 Ko
594 8.8 Ch	624 6.7 Th	655 10.1 Gy	631 6.1 Ah	622 8.2 Th	621 8.2 L
616 8.2 Jo	625 6.7 Jo	659 11.2 Sf	631 6.0 GD	623 7.8 Ah	629 8.0 Pt
618 7.8 Jo	626 6.9 Ah	U Lib	631 6.1 Pt	624 7.9 Ah	630 8.0 Pt
620 7.6 Jo	626 6.6 Th	*153620a*	632 6.1 Ah	624 8.2 Th	631 8.0 Pt
620 7.9 Ah	627 6.9 Ah	592[12.9 Bl	633 6.1 Be	626 8.2 Th	633 7.9 L
623 7.8 Ah	627 7.1 Mn	T Nor	633 6.0 Jo	626 7.9 Ah	636 8.1 Pt
624 7.7 Ah	628 6.8 Jo	*153654*	633 6.0 L	627 8.1 Ah	637 8.0 Ko
625 7.1 Jo	630 6.9 Ah	586 10.5 En	634 6.0 Ah	628 7.0 Mp	640 8.2 Pt

Variable Star Observations Received During November, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
SX Her	SS Her	R Dra	RT Her	RU Oph	R Pav
160325	162807	163266	170627	172809	*180363*
643 8.1 Pt	631 9.2 Th	637 10.5 Wd	618 9.7 Jo	659 10.5 Gy	588 8.2 En
645 7.9 L	631 9.0 Pt	644 10.0 Mn	618 9.7 Th	RT Ser	595 8.1 En
649 8.1 Pt	633 8.8 L	645 10.6 Sh	620 9.6 Jo	*173411*	613 8.1 En
650 8.1 Pt	645 9.7 L	645 10.7 Wd	620 9.6 Jo	617 12.7 L	T Her
651 8.2 Pt	T Oph	646 10.7 Jo	620 9.9 Th	RU Sco	180531
653 8.4 Pt	*162815*	649 10.9 Wd	622 10.0 Th	*173543*	617 12.6 GC
W Sco	593[12.8 Bl	650 10.9 Pc	625 9.7 Jo	588 10.4 En	619 12.3 GC
160519	S Oph	652 11.4 Wd	625 9.9 Ko	593 10.0 Bl	619 12.0 Bc
593[13.0 Bl	*162816*	654 11.2 Gy	626 10.2 Th	595 10.0 En	621 12.2 GC
RU Her	593 11.0 Bl	RR Oph	627 10.7 B	601 9.6 Bl	621 12.0 L
160625	600 11.0 Bl	*164319*	628 9.8 Jo	614 9.5 En	623 11.6 Ch
594 11.8 Ch	617 11.3 L	588 11.8 En	631 10.1 Th	SV Sco	624 11.3 Be
617 12.8 GC	W Her	595 12.0 En	631 10.0 Pt	*174135*	627 11.5 Ah
619 12.4 GC	163137	617 12.7 L	633 10.0 Jo	588[12.2 En	627 10.4 GC
621 12.1 L	594 8.8 Ch	S Her	637 10.4 Jo	593[12.7 Bl	628 10.8 GC
629 12.3 B	613 9.8 Th	164715	646 11.0 Jo	W Pav	630 11.2 Ah
631 12.9 Pt	616 9.7 Jo	625 12.3 Wy	649 11.0 B	*174162*	631 11.5 Pt
645 12.8 L	618 10.0 Th	630 11.6 B	RW Sco	588 12.3 En	632 11.3 L
R Sco	619 10.3 Jo	631 12.5 Pt	*170833*	593 12.5 Bl	633 11.2 Jo
161122a	621 10.2 Ko	RS Sco	588 12.3 En	595 12.3 En	643 9.7 HS
588 12.1 En	621 10.3 Ch	*164844*	593 11.5 Bl	RS Oph	645 10.5 L
593 12.4 Bl	622 10.7 Th	588 10.7 En	595 11.9 En	174406	646 9.7 Jo
595 12.6 En	624 10.9 Sz	593 10.3 Bl	600 10.9 Bl	631 11.0 Pt	650 9.5 HS
S Sco	624 10.5 Jo	595 10.9 En	613 10.9 En	U Ara	651 9.4 Me
161122b	627 10.4 B	600 10.9 Bl	α Her	*174551*	654 9.1 Me
593[13.0 Bl	631 11.0 Th	614 11.1 En	171114	588 10.7 En	654 9.2 HS
W CrB	633 11.3 Jo	RR Sco	617 3.4 Ko	595 10.9 En	654 9.0 Gy
161138	R UMi	*165030a*	625 3.4 Ko	T Dra	659 9.0 HS
620 10.8 Jo	163172	588 12.2 En	633 3.4 Ko	175458a	W Dra
629 11.4 B	616 9.8 Jo	593 11.4 Bl	Z Oph	617 11.7 GC	180565
631 11.4 Pt	617 10.1 GC	595 12.2 En	171401	619 11.7 GC	618 9.7 L
646 12.6 B	619 9.7 Jo	600 11.4 Bl	615 8.9 Th	620 11.6 GC	631 9.9 Pt
V Oph	623 9.6 L	614 11.4 En	617 9.0 Ah	621 11.6 GC	634 9.3 L
162112	624 9.9 Jo	RV Her	618 9.1 Th	627 11.7 GC	635 9.8 B
594 7.9 Ch	633 9.8 Jo	165631	620 9.1 Ah	630 10.8 B	654 10.0 Gy
625 7.3 L	637 10.0 Jo	617 13.4 GC	621 8.8 Jo	650 11.0 B	X Dra
631 7.5 Pt	645 9.9 L	617 13.2 L	623 9.2 Ah	UY Dra	180666
U Her	646 10.5 Jo	619 13.3 GC	624 9.0 Th	175458b	635 11.1 B
162119	R Dra	620 12.0 Jo	627 9.2 Ah	630 11.1 B	651 11.2 Pt
617 12.0 Jo	163266	624 13.0 Be	631 8.8 Pt	650 11.6 B	654 11.1 Gy
618 11.7 Jo	616 9.4 Jo	627 12.4 B	631 9.0 Th	RY Her	TV Her
620 11.2 Jo	617 9.9 Mn	628 11.7 Jo	632 9.4 Ah	175519	181031
621 11.5 Ch	619 9.6 Jo	631 12.2 Pt	637 9.4 Ah	619 9.5 Jo	617 14.1 L
625 11.2 Jo	620 9.4 Ah	633 11.4 Jo	RS Her	619 9.4 Mp	633 11.9 L
627 11.0 Jo	621 9.8 Ch	633 12.2 L	171723	621 9.4 Jo	RY Oph
629 11.5 B	623 10.0 Mn	637 11.4 Jo	627 12.1 B	621 9.6 L	181103
631 11.5 Pt	623 9.9 Ah	645 11.3 L	631 12.1 Pt	624 9.5 Ch	631 13.6 Pt
633 10.8 Jo	624 9.9 Ah	650 11.4 B	649 10.7 B	628 9.6 Mp	641 12.3 B
SS Her	624 9.9 Jo	RT Sco	S Oct	631 9.6 Pt	W Lyr
162807	626 10.0 Ah	*165636*	*172486*	634 10.2 L	181136
590 11.7 Cy	627 9.9 Ah	593[14.0 Bl	593 11.9 Bl	659 11.5 Bw	617 9.4 Jo
599 11.2 Cy	629 10.9 B	R Oph	601 12.3 Bl	V Dra	620 10.2 Jo
615 9.3 Th	630 10.2 Ah	*170215*	RU Oph	175654	620 10.0 Ah
617 8.8 GC	631 10.2 Ah	617 11.4 L	172809	619 9.6 Mp	621 10.0 L
618 9.4 Th	631 10.6 Pt	645 10.7 L	617 12.6 L	621 9.4 L	623 10.3 Ah
619 8.5 GC	633 10.2 Mn	RT Her	631 12.3 Pt	631 10.0 Pt	624 10.5 Ah
621 8.9 L	633 10.0 Jo	170627	633 12.3 L	634 9.6 L	626 10.6 Ah
624 9.3 Th	637 10.2 Jo	616 10.1 Jo	641 11.7 B		627 10.7 Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
W LYR	X OPH	R SCT	Z LYR	RW SGR	RY SGR
181136	183308	*184205*	185634	*190819a*	*191033*
627 10.4 Jo	652 8.4 HS	648 5.8 Pt	618 14.7 L	623 9.7 L	603 11.2 Bl
629 10.9 Ah	654 8.9 HS	649 5.8 Pt	RT LYR	628 9.2 GC	613 11.0 En
631 11.5 Pt	RS DRA	649 6.1 Mc	185737	631 9.0 Pt	617 11.2 L
634 11.0 Ah	184074	649 5.5 Hu	618 14.2 L	633 9.0 L	618 11.1 L
634 11.5 Jo	621 11.1 Ch	649 5.8 Mg	619[14.0 GC	BH SGR	621 11.0 Ch
634 11.8 L	RY LYR	650 6.3 Mc	620[14.0 GC	*190819b*	623 10.9 L
646 12.4 B	184134	650 5.8 Pt	V AQL	619 13.4 GC	625 10.8 L
653 12.9 Bg	618[14.1 L	650 5.8 Cy	*185905*	623 12.4 L	631 11.5 Pt
RV SGR	628[12.8 Mp	651 5.7 Pt	617 7.9 Mn	628 13.2 GC	633 10.6 L
182133	R SCT	652 5.5 Pt	618 8.7 Si	TY AQL	640 11.5 Pt
593 13.3 Bl	*184205*	653 5.6 Pt	621 8.7 Si	*190907*	643 11.5 Pt
SV HER	585 5.5 Cy	653 5.7 Bg	621 7.1 Ch	631 10.3 Pt	645 10.9 L
182224	586 5.5 Cy	653 6.1 Wd	624 7.7 Mn	S LYR	649 11.6 Pt
623 14.0 L	588 5.5 Cy	655 5.6 Gy	624 8.5 Si	190925	650 11.7 Pt
645[14.0 L	590 5.5 Cy	657 5.5 Pt	634 7.9 Mn	617[14.4 L	651 11.7 Pt
T SER	591 5.5 Cy	658 5.5 Me	645 7.8 Mn	625 13.8 B	653 11.5 Pt
182306	599 5.5 Cy	659 5.7 Mc	R AQL	646[12.9 Wy	TY SGR
631 13.0 Pt	616 5.8 Be	NOV AQL	190108	X LYR	*191124*
644 12.5 B	616 6.0 Jo	184300	594 8.4 Ch	190926	595[13.0 Bl
SV DRA	617 6.0 Mn	620 10.6 Jo	617 6.7 Ah	627 9.2 GC	599[12.4 En
183149	618 5.9 L	629 11.5 Pt	617 6.6 Mn	631 9.0 Pt	S SGR
617 10.3 L	619 6.1 Jo	634 10.7 Jo	617 6.5 Ko	RS LYR	*191319a*
633 11.9 L	619 5.9 Bc	646 10.6 Jo	618 6.9 Jo	190933a	595 13.5 Bl
RZ HER	621 5.9 Si	648 11.7 Pt	620 6.6 Ah	618 13.3 L	599 12.5 En
183225	621 6.1 Ch	R LYR	620 6.7 Jo	631 12.6 Pt	617 11.6 L
618[14.1 L	624 6.1 Mn	185243	623 6.4 Ah	645 12.4 L	639 10.7 L
645 14.0 L	624 5.9 Si	617 4.2 Ko	624 6.4 Ah	654 11.6 Gy	651 10.7 Pt
X OPH	627 6.5 Bc	617 4.2 Si	624 6.5 Mn	RU LYR	Z SGR
183308	629 7.1 Be	618 4.2 Si	625 6.3 Ko	190941	*191321*
583 7.6 Si	629 6.5 Pt	619 4.2 Si	626 6.2 Ah	631 14.4 Pt	591 9.5 En
588 7.8 Si	630 6.5 Pt	621 4.3 Si	627 6.2 Ah	U DRA	599 9.8 En
594 7.8 Si	630 6.9 Hu	621 4.3 Ko	628 6.2 Ah	190967	617 9.3 L
594 8.2 Ch	630 6.9 Mg	622 4.2 Si	630 6.3 Ah	621 10.7 Ch	624 9.4 Mp
595 7.8 Si	631 6.4 GD	623 4.2 Si	632 6.2 Ah	623 11.0 L	630 9.5 Mp
597 8.1 Si	631 6.8 Hu	624 4.2 Si	634 6.2 Ah	631 11.5 Pt	639 9.6 L
602 8.5 Si	631 6.7 Pt	624 4.3 Ko	634 5.9 Mn	644 11.2 L	SW SGR
617 8.4 Jo	632 6.5 L	626 4.3 Si	635 6.0 B	W AQL	*191331*
617 8.5 Mn	632 6.9 Hu	631 4.3 Si	637 6.2 Ah	*191007*	591[12.4 En
617 8.3 Ko	633 6.9 Hu	634 4.4 Ko	637 5.8 Ko	617 14.2 L	595[13.4 Bl
617 8.3 Si	633 6.7 Jo	646 4.3 Si	645 5.8 Mn	644[13.0 L	TZ CYG
618 8.3 Si	634 6.5 Be	S CRA	650 6.3 HS	T SGR	191350
620 8.4 Jo	634 6.8 Mn	*185437a*	652 6.7 B	*191017*	631 10.7 Pt
621 8.5 Si	634 6.7 Pt	588 11.9 En	652 6.5 HS	631 11.6 Pt	U LYR
623 8.5 L	635 6.5 Pt	593 12.5 Bl	654 6.1 HS	R SGR	191637
624 8.6 Mn	635 6.6 Bc	599 12.0 En	657 6.7 Ad	*191019*	617 8.4 Jo
624 8.5 Si	636 6.7 Pt	ST SGR	659 6.7 HS	599 12.5 En	620 8.6 Jo
627 8.5 Ko	637 6.9 Wd	*185512a*	V LYR	617 11.2 L	624 8.7 Jo
627 8.5 Jo	640 7.0 Wd	618 8.4 L	190529a	631 10.0 Pt	631 8.5 Pt
630 8.8 Ja	640 6.5 Me	634 8.7 L	631[12.8 Pt	639 9.2 L	634 8.6 Jo
631 8.5 Pt	640 6.3 Pt	645 8.7 L	RX SGR	RY SGR	646 8.6 Jo
634 8.4 Jo	643 6.0 Pt	R CRA	*190818*	*191033*	T SGE
634 8.7 Mn	643 6.3 GD	*185537a*	588[12.4 En	586 10.7 En	191717
641 8.5 B	645 6.0 L	588 12.5 En	623[13.1 L	591 10.0 En	621 9.3 GC
645 8.5 Ja	645 6.0 Mn	593 13.0 Bl	RW SGR	593 10.4 Bl	AF CYG
645 8.8 Mn	646 5.8 Jo	T CRA	*190819a*	594 10.0 En	192745
645 8.6 L	646 6.7 Wd	*185537b*	588 10.5 En	595 9.7 Bl	620 7.6 Ah
646 8.5 Jo	648 5.8 Hu	588[12.5 En	599 10.3 En	599 10.6 En	621 7.6 Ah
650 8.8 HS	648 6.0 Mc	593 13.0 Bl	619 9.4 GC	600 10.6 Bl	622 7.6 Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
AF Cyg	R Cyg	X Aql	χ Cyg	Nov Cyg	S Aql
192745	193449	194604	194632	195553	200715a
623 7.4 Ah	648 8.0 Mc	622 9.0 Th	631 5.9 Ah	633[12.2 Pt	659 11.3 Bg
624 7.1 Ah	649 7.7 Pc	626 8.9 Th	631 5.8 Hu	650[12.2 Pt	RW Aql
626 7.1 Ah	650 8.2 Mc	631 9.0 Th	631 5.4 Th	RR Tel	200715b
627 7.0 Ah	650 8.1 B	633 9.2 Jo	631 5.6 Me	*195656*	617 9.2 Jo
628 7.2 Ah	652 8.4 Wd	633 9.1 Pt	632 5.5 Th	591[12.6 En	620 9.3 Jo
629 7.1 Ah	654 8.8 Gy	639 9.5 L	632 5.7 Hu	Z Cyg	633 9.5 Pt
630 6.9 Ah	657 7.5 Ad	645 9.9 Sf	632 6.0 Ah	195849	651 9.2 Bg
631 6.9 Ah	RV Aql	646 9.9 B	634 6.3 Sh	617 8.7 L	653 9.2 Bg
632 7.0 Ah	193509	648 10.4 Mc	634 6.0 Ah	624 8.9 Mp	659 9.2 Bg
634 6.8 Ah	618 12.3 L	650 10.5 Mc	636 6.0 Ah	630 9.0 Mp	R Tel
636 6.8 Ah	633 11.9 Pt	650 10.2 Sf	636 5.9 Bg	631 8.8 Me	*200747*
637 6.8 Ah	639 10.4 L	659 10.6 Sf	637 6.1 Ah	633 8.8 Pt	591 11.4 En
TY Cyg	T Pav	659 10.6 Mc	637 6.4 Wd	635 8.7 B	596 12.0 Bl
192928	*193972*	χ Cyg	639 6.4 Sh	644 9.0 L	RU Aql
618 14.0 L	591 13.3 En	194632	640 6.0 Ja	652 9.5 B	200812
645 13.8 L	595 13.1 Bl	581 5.2 Si	640 6.0 Me	S Tel	618 13.6 L
RT Aql	RT Cyg	582 5.1 Si	641 6.3 Wd	*195855*	625 13.8 B
193311	194048	583 5.3 Si	644 6.4 Ja	591 12.9 En	W Cap
618 10.7 L	618 12.2 Jo	589 5.0 Si	645 6.5 Sh	596 13.0 Bl	*200822*
619 10.9 GC	619 11.7 GC	598 4.9 Si	645 6.6 Wd	SY Aql	595 11.8 Bl
621 10.9 GC	620 12.0 GC	601 4.9 Si	645 6.3 Bg	200212	601 12.1 Bl
627 10.8 GC	620 11.5 Ah	602 4.9 Si	646 6.3 Bg	618 9.5 L	Z Aql
631 11.2 Pt	620 12.5 Jo	605 4.9 Si	646 6.5 Wd	625 9.4 B	*200906*
639 11.3 L	621 11.9 GC	614 5.2 Ch	646 6.7 Si	632 9.5 Wy	624 11.2 Mp
644 11.6 B	623 11.7 Ah	615 5.0 Th	647 6.5 Sh	633 9.5 Pt	630 10.6 Mp
R Cyg	624 12.0 Ah	616 5.2 Si	651 6.4 Bg	639 9.3 L	636 10.3 Bg
193449	627 11.9 GC	617 4.7 Jo	652 6.6 Wd	646 9.3 B	641 9.7 B
617 7.4 Si	628 11.9 GC	617 5.1 Si	653 6.6 Bg	649 9.5 Md	651 9.2 Bg
618 7.7 Jo	633 11.9 Pt	617 5.1 Ah	655 6.6 Gy	655 9.5 Gy	652 9.8 Pt
620 7.2 Jo	633 12.2 Jo	618 5.3 Si	657 6.8 Ad	S Cyg	R Sge
620 7.6 Ah	635 11.5 B	618 5.2 Ah	658 7.2 Me	200357	200916
621 7.5 Si	637 11.2 Wd	618 4.9 Th	659 7.0 Bg	633 12.3 Pt	617 10.1 Jo
622 7.2 Ah	641 11.2 Wd	619 4.9 Th	S Pav	635 11.5 B	620 10.6 Jo
623 7.4 Ah	646 12.0 Jo	619 5.4 Si	*194659*	646 10.6 Wd	RS Cyg
623 7.2 Si	648 9.5 Mc	620 5.2 Ah	591 7.4 En	649 10.7 Pc	200938
624 7.5 Si	649 10.4 Pc	620 4.9 Jo	599 7.7 En	652 10.4 B	571 8.7 Cy
624 7.6 Ah	650 9.4 Mc	621 5.4 Ah	RR Sgr	655 10.3 Gy	585 8.3 Cy
626 7.4 Ah	652 10.2 Wd	621 5.4 Si	*194929*	R Cap	590 8.2 Cy
627 7.8 Ah	652 9.9 B	621 5.2 Th	591 13.0 En	*200514*	616 8.8 Si
628 7.7 Ah	654 10.0 Gy	622 5.1 Th	595[13.2 Bl	618 10.1 L	617 8.7 Si
628 7.8 We	TU Cyg	622 5.4 Si	599[12.8 En	645 11.4 L	618 8.5 Si
629 7.7 Ah	194348	622 5.4 Ah	RU Sgr	652 11.1 Pt	618 8.1 Jo
630 7.5 Ah	618 13.0 L	623 5.5 Ah	*195142*	SV Cyg	618 8.0 L
631 7.8 Ah	619 13.3 GC	623 5.5 Si	591 8.8 En	200647	619 8.4 Si
632 7.8 Ah	620 13.3 GC	624 5.6 Ah	595 9.5 Bl	621 9.7 GC	620 7.8 Jo
633 7.5 Pt	620 12.6 Ry	624 5.5 Si	599 10.2 En	627 9.7 GC	621 8.6 Si
633 7.5 Ja	622[12.4 Ry	624 5.6 Ch	601 9.9 Bl	S Aql	623 8.6 Si
633 7.2 Jo	627[13.3 GC	624 5.2 Th	RR Aql	200715a	624 8.6 Si
634 7.7 Ah	633[13.0 Pt	626 5.7 Ah	*195202*	617 10.5 Jo	624 8.8 Ch
635 7.9 B	636[12.4 Ry	626 5.7 Si	621 14.0 L	620 10.8 Jo	629 8.2 Ja
636 7.9 Ah	649[12.5 Pc	627 5.7 Ah	630 13.5 B	630 10.8 Me	630 8.2 Ja
637 8.0 Wd	X Aql	628 5.8 Ah	646 13.6 B	633 11.3 Pt	630 8.0 GD
637 7.8 Ah	194604	629 5.8 Ah	RS Aql	635 10.8 B	633 8.0 L
640 7.5 Ja	613 8.9 Th	630 5.9 Ah	*195308*	636 10.8 Bg	633 7.8 Pt
641 7.9 Wd	617 8.7 Jo	630 5.7 Hu	618 10.5 L	648 11.6 Me	634 7.7 Jo
644 7.5 Ja	618 9.1 L	630 6.1 Ja	644 11.8 L	651 11.7 Bg	637 8.6 Wd
645 8.2 Wd	618 9.0 Th	630 5.6 Me	644 12.1 B	653 11.7 Bg	640 7.8 Ja
646 7.6 Jo	620 8.9 Jo	631 5.8 Si		653 11.3 Me	641 8.6 Wd

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RS CYG	WX CYG	Z DEL	Y AQR	RZ CYG	RS AQR
200938	201437b	202817	*203905*	204846	*210504*
644 7.8 Ja	620 11.8 Jo	653[13.6 Bg	650 9.9 Pc	645 13.4 B	623 13.9 L
645 8.2 Sh	633 11.7 L	ST CYG	651 9.6 Bg	648 13.2 Pt	646 13.6 L
645 8.5 Wd	633 11.2 Pt	202954	652 9.9 B	S IND	Z CAP
646 7.9 L	634 12.0 Jo	619 13.2 GC	T DEL	*204954*	*210516*
646 8.5 Si	635 10.8 B	620 13.0 GC	204016	591 8.4 En	623 11.7 L
648 7.7 Me	646 11.8 L	621 13.0 GC	624 13.7 Br	596 8.3 Bl	625 11.8 B
650 7.5 Cy	646 12.1 Me	624 13.5 Br	625 13.6 L	601 8.9 Bl	633 12.3 L
650 8.3 HS	649 11.9 Md	625 13.9 L	644 12.9 L	X DEL	646 13.1 L
652 8.3 Wd	652 11.9 B	627 13.0 GC	645 12.6 B	205017	648 13.0 Pt
656 7.0 Al	656 11.8 Al	628 13.1 GC	648 13.4 Pt	623 8.9 L	R EQU
657 7.2 Ad	659 11.5 Bg	633 13.5 Pt	V AQR	631 9.2 Me	210812
659 8.3 HS	V SGE	645 13.3 B	204102	632 9.2 Hu	625 13.9 L
R DEL	201520	646 13.9 L	621 7.9 L	644 9.9 B	646 14.5 L
201008	630 9.6 Me	V VUL	627 8.2 B	644 10.1 L	648 14.2 Pt
586 11.8 Cy	653 12.0 Bg	203226	644 7.8 L	648 10.1 Pt	T CEP
617 10.0 Ko	U CYG	633 8.9 Pt	648 8.0 Pt	648 10.6 Hu	210868
618 10.0 Th	201647	R MIC	649 8.3 Md	649 10.3 Md	617 8.2 Mn
620 9.8 Ah	618 8.3 Jo	*203429*	652 8.6 B	649 10.2 Hu	618 8.5 Si
621 9.3 L	620 8.5 Jo	591 13.0 Fn	W AQR	653 10.4 Bg	620 7.4 Jo
622 9.8 Th	624 8.6 Jo	595 12.8 Bl	*204104*	658 11.0 Hu	620 8.2 Ah
623 9.8 Ah	627 10.2 GC	Y DEL	590 10.7 Cy	RR CAP	621 8.0 Ah
624 9.6 Ah	628 8.9 Jo	203611	621 11.7 L	*205627*	621 8.2 Ch
626 9.4 Ah	630 8.5 GD	621 13.1 L	644 12.4 L	591 9.8 En	623 7.9 Ah
627 9.3 Ah	633 8.0 Pt	624 14.1 Br	652 12.8 B	R VUL	623 8.3 Mn
627 9.3 Ko	633 8.0 Ja	645 13.6 L	U CAP	205923a	624 8.2 Ah
630 9.2 Ah	637 8.4 Wd	649 13.9 B	*204215*	620 8.8 Jo	627 8.1 Ah
631 9.2 Th	638 8.0 B	S DEL	596 13.0 Bl	620 9.0 Ah	630 8.1 Ah
633 9.0 Pt	640 7.8 Ja	203816	621 13.5 L	622 8.9 Ah	631 8.1 Ah
635 8.9 B	641 8.9 Wd	633 10.9 Pt	V DEL	623 8.9 Ah	632 8.2 Ah
636 8.7 Bg	644 7.8 Ja	650 9.7 B	204318	624 9.1 Ah	633 8.3 Mn
637 9.2 Ah	645 8.8 Wd	653 9.9 Bg	624[14.4 Br	626 9.2 Ah	636 7.5 Jo
644 8.7 L	646 9.6 Sf	656 9.0 Md	630[13.9 B	627 9.3 Ah	637 8.1 Ah
645 8.7 Sf	648 9.6 Mc	658 9.7 Hu	644[13.4 B	629 9.3 Ah	641 8.1 Wd
646 9.0 Wy	649 8.0 Md	V CYG	649[13.9 B	630 9.6 Ah	644 8.3 Mn
650 8.7 Sf	650 9.5 Mc	203847	T AQR	631 9.9 Me	645 7.9 Sh
650 8.8 B	650 9.6 Sf	617 11.7 L	*204405*	644 10.9 B	645 8.0 Wd
651 8.6 Bg	652 8.0 GD	633 10.0 Ja	594 9.2 Ch	646 11.1 Wy	647 7.6 Sh
658 8.6 Me	652 8.7 Wd	640 10.0 Ja	616 8.6 Mn	648 11.4 Pt	648 7.8 Pt
659 8.7 Sf	652 9.2 HS	644 10.0 Ja	616 8.4 Jo	V CAP	649 8.0 Wd
659 8.7 Ie	654 9.1 HS	645 9.3 L	618 8.7 Th	*210124*	652 7.9 Wd
SX CYG	656 8.0 GD	646 9.8 Sf	619 8.2 Jo	591 9.2 En	654 8.4 Gy
201130	659 9.2 HS	648 9.2 Pt	621 7.9 Jo	596 9.0 Bl	656 7.9 Al
586[12.9 Cy	659 9.2 Sf	649 9.7 Me	622 8.4 Th	601 9.7 Bl	RR AQR
624[13.1 Br	U MIC	649 9.5 Pc	624 8.3 Mn	621 10.2 L	*210903*
633 13.9 Pt	*202240*	650 9.8 Sf	624 8.4 Be	645 10.8 L	623 11.4 L
653[13.1 Bw	595 12.8 Bl	650 9.2 B	626 8.3 Th	659 11.7 Gy	633 11.7 L
RT SGR	RW CYG	654 10.0 HS	627 8.5 B	TW CYG	644 12.4 B
201139	202539	659 10.0 HS	630 8.6 Mp	210129	648 12.4 Pt
591 11.0 En	659 8.6 Me	659 9.8 Sf	631 8.5 Me	625 13.0 L	X PEG
595 10.9 Bl	RU CAP	Y AQR	631 8.4 Th	646 13.9 L	211614
601 10.9 Bl	*202622*	*203905*	634 8.5 Mn	651 13.9 B	623 12.7 L
WX CYG	591[12.0 En	619 11.7 Jo	645 9.3 Mn	X CAP	624 12.3 Br
201437b	Z DEL	621 12.0 Jo	648 9.3 Pt	*210221*	632 12.7 Hu
585 10.4 Cy	202817	624 12.5 Mp	649 9.2 Me	593[12.7 En	633 13.2 L
590 11.1 Cy	621[13.9 L	627 12.4 B	650 9.4 Pc	596[12.7 Bl	646 13.3 B
599 11.6 Cy	624[13.9 Br	630 12.1 Mp	652 9.1 B	X CEP	648 13.5 Pt
618 11.7 L	630[12.9 Mp	648 10.0 Pt		210382	649 13.5 Pc
618 11.7 Jo	646[14.4 L	649 10.0 Me		649 11.8 Pc	

Variable Star Observations Received During November, 1931.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T Cap	RV Cyg	Y Peg	R Lac	RY Cep	RR Cas
211615	213937	220613	223841	231878	235053
596 10.1 Bl	627 7.9 GC	648 12.2 Pt	646 13.4 L	623 9.3 Ch	632 13.0 B
601 10.0 Bl	648 6.6 Pt	RS Peg	648 14.5 Pt	V Phe	647 12.7 Bn
623 10.0 L	RR Peg	220714	S Aqr	*232746*	653 12.0 Al
630 9.9 B	214024	618 9.7 L	*225120*	594[12.7 En	659 11.9 Bn
644 10.9 L	627 13.0 GC	644 11.0 L	652 9.5 B	Z And	R Phe
646 11.1 B	628 13.0 GC	648 10.9 Pt	RW Peg	232848	*235150*
S Mic	646[13.0 Eb	656 11.5 Md	225914	649 10.7 Pt	594 9.0 En
212030	μ Cep	R PsA	623 13.8 L	652 11.3 Bw	V Cet
593[13.4 En	214058	*221230*	633 13.5 L	659 11.0 Bw	235209
596[13.4 Bl	617 4.1 Ko	593[12.9 En	649 13.0 Pt	ST And	596 10.6 Bl
Y Cap	621 4.1 Ko	X Aqr	β Peg	233335	624 12.9 Br
212814	634 4.1 Ko	*221321*	225927	594 11.0 Ch	R Tuc
596 12.7 Bl	R Gru	593[13.2 En	617 2.6 Ko	616 11.5 Jo	*235265*
601 12.7 Bl	*214247*	T Gru	621 2.6 Ko	618 10.6 Jo	594 11.4 En
623 12.2 L	591 13.7 En	*221938*	624 2.5 Ko	621 10.6 Jo	602 11.8 En
630 11.7 B	596 13.3 Bl	594 11.3 En	634 2.4 Ko	625 10.9 Wy	R Cas
644 12.5 L	602 12.9 En	602 11.4 En	646 2.7 Ko	632 10.8 B	235350
646 12.3 B	613 12.4 En	S Gru	R Peg	634 10.8 Jo	616 10.5 Mn
W Cyg	V Peg	*221948*	230110	634 11.0 Bo	616 10.9 Jo
213244	215605	591 9.2 En	620 9.5 Ah	639 10.8 Bo	620 10.8 Jo
618 6.4 L	623 10.8 L	602 9.3 En	623 9.5 Ah	646 10.7 Bo	634 10.9 Jo
633 5.9 L	644 8.6 L	613 9.6 En	624 9.4 Ah	649 10.8 Bo	634 10.6 Mn
646 6.2 L	646 8.5 Co	RV Peg	626 9.5 Ah	649 10.8 Pt	637 11.0 Jo
S Cep	648 8.5 Pt	222129	627 9.6 Ah	651 10.6 Al	644 10.6 Mn
213678	653 8.4 Al	625 13.7 L	630 9.7 Ah	653 10.5 Al	646 11.0 Wd
618 10.2 Th	656 8.2 Md	632 12.9 Hu	631 9.5 Ah	655 10.7 Bo	648 12.6 Br
620 10.2 GC	U PsA	646 13.9 L	645 9.6 Sf	658 10.6 Bo	655 11.9 Gy
621 10.5 GC	*215628*	S Lac	649 9.8 Pt	659 10.2 Al	Z Peg
624 10.1 Th	593[12.2 En	222439	650 9.8 Sf	R Aqr	235525
627 10.3 GC	U Aqr	615 9.1 Th	653 10.4 Al	*233815*	625 13.3 L
628 10.0 GC	*215717*	617 9.4 Ko	655 9.6 Gy	594 8.4 Ch	646 12.5 L
632 10.1 Th	623 12.4 L	622 9.9 Th	659 9.9 Sf	594 8.6 En	648 12.7 Br
644 9.2 B	644 12.1 L	625 9.9 L	V Cas	596 8.3 Bl	649 12.4 Pt
648 8.8 Pt	648 12.2 Pt	625 10.1 Ko	230759	618 9.0 We	655 12.0 Gy
RU Cyg	652 12.2 B	626 10.3 Th	623 11.4 Ch	622 8.1 Th	W Cet
213753	S PsA	631 11.0 Th	632 10.7 B	623 8.7 L	*235715*
620 9.9 Ah	*215828*	634 10.5 Bo	649 10.3 Pt	626 8.8 Mn	622 9.4 Th
620 9.9 Ry	593 9.2 En	635 10.7 L	650 10.5 B	626 8.5 Th	626 9.3 Th
623 9.8 Ah	RT Peg	639 10.8 Bo	W Peg	629 8.8 We	626 9.3 Mn
624 9.8 Ah	215934	646 11.4 Bo	231425	633 8.8 L	631 9.4 Th
626 9.8 Ah	622 10.3 Th	648 11.7 Pt	616 10.4 Jo	633 8.8 Mn	633 9.4 Mn
626 9.9 Ry	626 10.1 Th	649 11.6 Bo	618 10.3 Jo	645 8.9 Mn	645 9.5 Mn
627 9.7 Ah	627 10.1 Th	653 11.8 Al	621 10.4 Jo	649 8.9 Pt	Y Cas
630 9.6 Ah	656 9.8 Md	655 11.7 Bo	624 10.4 Jo	650 8.8 Me	235855
631 9.5 Me	RY Peg	656 12.1 Md	625 10.9 L	Z Cas	624 14.0 Br
632 9.7 Ah	220133a	R Ind	635 11.4 L	233956	625 14.0 L
633 9.4 Ry	648 11.7 Pt	*222867*	650 11.7 Bw	624 13.7 Br	646 14.0 L
633 9.0 Jo	RZ Peg	596 12.5 Bl	653 11.2 Al	625 13.6 L	SV And
636 9.4 Ry	220133b	601 12.3 Bl	659 12.4 Bw	635 13.7 L	235939
639 9.5 Ja	625 12.2 L	T Tuc	S Peg	648 14.3 Br	645 12.8 B
646 9.0 Wy	646 12.6 L	*223462*	231508	Z Aqr	649 12.7 Pt
648 8.7 Pt	T Peg	591 11.8 En	625 12.6 Mp	*234716*	652 12.5 Bw
649 9.4 Me	220412	R Lac	625 12.6 L	626 9.8 Th	659 12.4 Bw
650 9.2 Bw	623 14.2 L	223841	645 11.5 L	TX Cep	
657 9.0 Bw	646 14.3 L	624 13.1 Br	649 11.8 Pt	234875	
	659[13.8 Bw	625 12.7 L		624 13.0 Br	
				648 13.1 Br	

Rapidly Varying Irregular Variables.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX Andromedae—						
	6617.3	11.7	Be	6635.7	11.5	Pt
	6618.3	12.1	Ry	6636.5	10.7	Ry
	6619.3	12.5	Ry	6636.9	11.3	Pt
	6620.4	12.8	Ry	6639.5	12.1	Ry
	6622.5	13.2	Ry	6640.5	12.4	Ry
	6623.5	12.8	Ry	6643.7	13.0	Pt
	6624.7	13.0	Br	6645.3	12.1	Ry
	6626.4	12.8	Ry	6648.6	11.8	Me
	6627.4	13.0	Ry	6648.7	11.3	Br
	6628.5	13.2	Ry	6648.7	11.6	Pt
	6629.7	12.4	Pt	6649.7	11.5	Pt
	6630.0	11.1	Br	6650.7	11.4	Pt
	6630.7	11.5	Pt	6651.5	11.4	Me
	6631.6	10.5	Me	6651.6	11.6	Pt
	6631.7	11.5	Pt	6652.7	11.7	Pt
	6632.9	11.3	Pt	6653.6	11.8	Pt
	6633.3	10.9	Ry	6654.8	12.4	Pt
	6633.7	11.5	Pt	6655.7	13.0	Pt
	6634.5	10.8	Ry	6656.5	12.1	Me
	6634.7	11.3	Pt	6657.7	13.0	Pt
	6635.4	10.7	Ch	6658.5	12.1	Me
	6635.5	10.6	Ry			
060547 SS Aurigae—						
	6591.8	12.4	Cy	6639.8	12.5	Pt
	6611.3	13.0	Ch	6644.4	12.5	L
	6617.6	12.5	L	6645.3	12.5	L
	6618.6	13.9	L	6646.3	12.5	L
	6624.9	11.7	Br	6648.7	12.5	Pt
	6627.7	11.6	Cy	6649.7	12.5	Pt
	6628.6	13.5	L	6650.7	13.8	Pc
	6629.7	13.9	L	6651.6	12.0	Me
	6630.0	14.4	Br	6652.7	12.6	Pt
	6631.7	11.8	Me	6653.8	12.6	Pt
	6632.6	14.5	L	6655.7	12.6	Pt
	6633.7	12.5	L	6658.6	12.3	Me
	6634.3	13.9	Ch	6659.6	13.9	Ie
	6635.7	11.0	Pt	6660.6	14.3	Lg
	6636.9	12.6	Pt			
074922 U Geminorum—						
	6617.7	13.3	L	6634.4	13.9	Ch
	6618.7	13.3	L	6635.6	10.8	L
	6625.6	13.8	L	6636.9	9.6	Pt
	6628.7	13.7	L	6639.8	9.0	Pt
	6629.7	13.8	L	6644.6	9.5	L
	6630.0	14.2	Br	6649.7	12.0	Pc
	6631.9	13.3	Pt	6653.8	12.4	Pt
	6632.7	13.8	L	6654.8	12.4	Pt
	6633.7	13.9	L	6660	13.9	Lg
081374 Z Camelopardalis—						
	6617.3	11.1	L	6630.6	13.0	Hu
	6617.7	11.5	L	6630.7	12.3	Pt
	6618.3	11.3	L	6631.7	12.8	Hu
	6618.6	11.8	L	6631.7	12.5	Pt
	6620.4	12.2	Be	6632.2	11.3	L
	6621.3	13.0	L	6632.7	11.2	L
	6623.3	13.0	L	6632.8	11.0	Me
	6625.6	12.8	L	6632.9	10.5	Pt
	6628.6	12.7	L	6633.3	11.0	L
	6630.0	12.9	Br	6633.6	11.0	L

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
081374 Z Camelopardalis—						
	6633.7	10.5	Pt	6649.7	13.0	Pt
	6634.7	10.9	Pt	6650.7	13.3	Pt
	6634.8	11.0	Me	6651.6	13.3	Pt
	6635.6	11.2	L	6652.7	13.2	Pt
	6635.7	10.9	Pt	6653.8	13.3	Pt
	6636.2	11.4	L	6654.8	10.9	Pt
	6636.6	11.5	Bg	6655.7	10.7	Pt
	6636.9	11.0	Pt	6656.5	11.0	Me
	6639.3	11.8	L	6658.5	11.4	Me
	6644.4	12.8	L	6658.7	11.1	Hu
	6645.3	13.0	L	6659.5	11.5	Me
	6646.3	13.0	L	6659.7	11.6	Bg
	6648.7	13.1	Hu	6660	11.3	Lg
	6648.7	12.5	Pt			
094512 X Leonis—						
	6631.9	13.3	Pt			
202946 SZ Cygni—						
	6629.7	9.5	Pt	6643.7	9.1	Pt
	6630.7	9.5	Pt	6648.7	9.7	Pt
	6631.7	9.5	Pt	6649.7	10.0	Pt
	6632.9	9.4	Pt	6650.7	9.8	Pt
	6633.7	9.4	Pt	6651.6	9.8	Pt
	6634.7	9.6	Pt	6652.7	9.8	Pt
	6635.7	9.5	Pt	6653.6	9.7	Pt
	6636.7	9.7	Pt	6654.8	9.0	Pt
	6639.8	8.8	Pt	6655.7	8.8	Pt
	6640.7	8.8	Pt	6657.7	8.8	Pt
213843 SS Cygni—						
	6559.7	12.0	Cy	6621.6	8.5	Jo
	6571.6	12.2	Cy	6622.4	8.9	Ah
	6585.6	12.0	Cy	6622.7	8.8	We
	6586.6	12.0	Cy	6623.3	8.9	Ah
	6588.6	12.0	Cy	6623.3	8.9	L
	6590.6	11.9	Cy	6623.8	8.8	We
	6591.7	11.9	Cy	6624.3	8.8	Be
	6594.1	11.8	Ch	6624.4	9.3	Ah
	6611.3	9.2	Ch	6624.5	9.3	Ah
	6616.4	8.7	Ah	6624.6	9.3	Jo
	6616.6	8.4	Jo	6624.7	9.2	Br
	6617.3	8.4	Ah	6624.7	9.0	We
	6617.3	8.7	L	6625.3	9.1	L
	6617.6	8.5	Jo	6625.7	9.2	We
	6617.7	8.4	We	6625.8	9.9	Jo
	6618.6	8.5	Jo	6626.2	9.4	L
	6618.6	8.7	L	6626.3	10.1	Ah
	6618.7	8.6	We	6626.7	10.3	Br
	6619.5	8.8	Bc	6626.7	9.8	We
	6619.6	8.5	GC	6627.3	10.4	Ah
	6619.6	8.5	Jo	6627.6	10.3	GC
	6619.7	8.8	We	6627.6	10.7	Jo
	6620.3	8.5	Ah	6627.7	10.0	Cy
	6620.4	8.7	Ah	6627.7	10.6	We
	6620.4	8.4	Be	6628.4	10.6	Ah
	6620.5	8.7	Bc	6628.6	10.6	GC
	6620.6	8.6	GC	6628.6	11.0	Jo
	6620.6	8.5	Jo	6628.6	10.9	L
	6621.3	8.8	L	6628.6	11.2	We
	6621.4	8.7	Ah	6629.4	10.9	Ah
	6621.6	8.3	GC	6629.7	11.7	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING NOVEMBER, 1931.

Star	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.
213843 SS CYGNI—								213843 SS CYGNI—							
	6630.7	11.6	Mg		6636.2	11.4	L		6646.7	11.2	Co		6652.6	11.4	Wd
	6631.4	11.6	Ah		6636.6	12.0	Jo		6648.6	11.5	Mg		6652.7	11.7	Pt
	6631.6	11.9	Me		6636.6	11.9	Bg		6648.6	11.3	Me		6653.6	11.7	Pt
	6631.7	11.8	Hu		6636.7	11.7	Pt		6648.7	12.1	Hu		6653.6	11.8	Al
	6631.7	11.7	Pt		6637.6	11.8	Jo		6648.7	11.7	Pt		6653.6	11.6	Bg
	6632.2	11.4	L		6637.6	11.8	Wd		6648.7	11.6	Br		6653.6	11.4	Me
	6632.5	11.8	Ah		6639.3	11.5	L		6649.5	11.8	Me		6653.6	11.9	Mg
	6632.6	11.7	L		6639.8	11.7	Pt		6649.6	11.6	B		6654.5	11.8	Sf
	6632.7	11.9	Hu		6640.7	11.7	Pt		6649.6	12.0	Hu		6654.8	11.6	Pt
	6632.7	11.5	Md		6640.8	11.8	Ma		6649.6	11.8	Pc		6655.7	11.7	Pt
	6632.8	11.7	Me		6641.6	11.5	Wd		6649.7	11.7	Pt		6656.5	11.7	Me
	6632.9	11.7	Pt		6642.5	11.6	Bc		6649.7	11.7	Md		6656.7	11.7	Md
	6633.2	11.4	L		6643.7	11.6	Pt		6650.6	11.3	Cy		6657.7	11.7	Pt
	6633.6	12.0	Jo		6644.4	11.4	L		6650.6	11.5	Ie		6658.5	11.5	Me
	6630.3	11.3	Ah		6644.6	11.3	B		6650.6	11.8	Pc		6658.7	11.6	Me
	6630.6	11.3	Me		6644.7	11.6	Br		6650.6	11.7	Sf		6658.7	11.4	Hu
	6630.7	11.7	Pt		6645.3	11.2	L		6650.6	11.9	Mg		6659.5	11.8	Sf
	6630.7	10.8	Hu		6645.6	11.3	B		6650.7	11.4	Pt		6659.5	11.8	Ie
	6633.7	11.7	Pt		6646.2	11.4	L		6650.7	11.8	Ma		6659.6	11.6	Bg
	6634.6	12.0	Jo		6646.6	11.3	B		6650.7	11.4	Me		6660.6	11.8	Wy
	6634.7	11.7	Pt		6646.6	11.9	Wy		6651.5	11.3	Me		6669.5	8.9	Cy
	6634.8	12.0	Me		6646.6	11.7	Jo		6651.6	11.6	Pt		6670.7	8.7	Jo
	6634.8	11.9	Ma		6646.6	11.3	Wd		6651.6	11.7	B		6671.6	8.7	Jo
	6635.6	11.6	L		6646.6	11.7	Sf		6652.6	11.9	Sf				
	6635.7	11.7	Pt		6646.7	11.5	Eb								

SUMMARY FOR NOVEMBER, 1931.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Aldwell	Ad	4	4	Kohman	Ko	16	45
Ahnert	Ah	41	320	Lacchini	L	159	372
Allen, P. R.	Al	15	17	Logan	Lg	4	4
Baldwin	Bl	77	114	MacPherson	Mp	17	24
Benini	Be	9	18	Marsh	Ma	9	18
Bigelow	Bw	18	22	McLeod	Mc	18	47
Boutell	Bo	10	49	Meek	Me	45	85
Bouton	B	87	121	Mennella	Mn	22	81
Brocchi	Br	48	57	Millard	Md	12	14
Brown, A. N.	Bn	4	13	Monnig	Mg	3	8
Buckstaff, R.N.	Bc	2	7	Paul	Pl	1	1
Bunting	Bg	17	32	Peltier	Pt	148	350
Chandra	Ch	55	89	Proctor	Pc	23	24
Cilley	Cy	17	53	de Roy	Ry	7	42
Cole	Co	3	3	Shultz	Sz	4	6
Ebert	Eb	3	3	Simpson	Si	14	89
Ensor	En	68	128	Smith, F. W.	Sf	16	42
Georgetown	GC	21	56	Smith, L.	Sh	4	8
Godfrey Club	GD	5	10	Smith, R	Sr	1	1
Gregory	Gy	29	29	Stearns	Sj	1	3
Haas	HS	7	19	Theile	Th	22	87
Houston	Hu	14	48	Webb	Wd	20	55
Iedema	Ie	6	7	Wetherbee	We	7	19
Jansen	Ja	8	20	Whitney	Wy	27	28
Jones	Jo	86	338				
				Totals		49	400	3030

sin, who is using the 6-inch telescope formerly in the possession of Professor Burnham. Mr. C. T. Vorhies, formerly at Tucson, Arizona, has transferred to

Seattle, Washington. Mr. Balfour S. Whitney, formerly quite active in our ranks, has returned to Norman, Oklahoma, where once again he has taken up active observing, using the 6-inch Eaton telescope. Secretary Olcott is comfortably situated for the winter in Tucson, Arizona, where, besides training prospective observers in the art of variable star observing, he is doing some plate research work at the Stewart Observatory under the direction of Dr. Carpenter.

The date of the Spring Meeting of the Association has been set for May 7, 1932, and it will be held at Hood College, Frederick, Maryland, at the invitation of Professor Leah B. Allen.

LEON CAMPBELL, Recorder.

December 11, 1931.

Meteor Notes

By CHARLES P. OLIVIER

Enough reports have now come in to give a more nearly complete summary of the observations of the Leonids of last month. While we still have but few from ships at sea, reports have come from most parts of the United States, and some from Canada and Hawaii, covering quite well the period from November 13 to 18 inclusive. The maximum was a strong one, occurring on the night of November 16-17, and apparently with the highest rates observed near the Atlantic seaboard. The rates so far reported from California and Hawaii are lower, but some of our best A.M.S. observers in that area are still to be heard from. A good hourly rate was obtained by the few who observed on November 17-18, and scattering Leonids were still coming on November 18-19.

Organized efforts were made in widely separated places. In this paper will be noted the complete set from the U. S. Naval Observatory, from which indeed are omitted those made on almost entirely cloudy nights during which the observers saw very few—too few to be useful in discussion. Cloudy weather at Washington on all the dates of the shower greatly hampered observations. A very complete set was also received from the Durham High School, where watch was kept for four full nights, and from the Barnard Astronomical Club, Nashville, Tennessee, which is made up of high school boys. Mr. K. E. Gell of East High School, Rochester, New York, was ready with a party for five nights, and many others had at least one person to assist them. The Beta Chapter of Alpha Nu, at Denver, Colorado, and the Alpha Chapter at the University of Colorado, Boulder, Colorado, sent in an excellent report, based on observations by 10 and 11 members, respectively, for two nights. As this is a particularly complete record, made by large, thoroughly organized groups, it will be discussed at some length.

At Denver, on November 15-16, from 15 to 17 hours, M.S.T., sky clear, eastern half observed by 6 persons, 21 Leonids were seen. On November 16-17, from 15 to 16 hours, M.S.T., sky clear, but hazy at end of period, 10 observers, 92 Leonids were seen. At Boulder, on November 15-16, between 14 and 17 hours, M.S.T., sky clear, 6 observers counted separately. The average rate of the 6 was 11.7 meteors per hour, maximum 13.3 for person observing to S.E., minimum 6.8 for person observing to W. On November 16-17, from 14 to 17 hours, sky clear first and last hour but only western part clear from 15 to 16 hours, 11 observers got an average rate of 43.3 meteors per hour; maximum being 52.9 for person observing to N, minimum 28.1 for person observing to W, later to E.

Lieut. C. W. Van Horn, U.S.N., on the *Patoka* in lat. 28° 37′ N., long. 91° 52′ W., from 4:00 A.M. to daybreak of November 17 (civil time) reports a most brilliant display. He counted 60 meteors in 15 minutes, and observed many brilliant ones, which left fine trains, some persisting for several minutes. Capt. A. Mackey on Am. *S.S. Charles G. Black*, lat. 20° 25′ N., long. 74° 03′ W., on November 17 (civil time) reports that 3 remarkable meteors and "a great many smaller bodies" were observed until 4:00 A.M. These two reports confirm our conclusion that, so far, the eastern part of America was the more favored region, and that the shower was less brilliant on the west coast.

Five stations had good success on November 16-17 along or near the Atlantic seaboard, and their results will be tabulated: (A) K. E. Gell and 2 assistants, on Gannit Mt., Ontario, New York (2150 ft. altitude); (B) J. S. Kingsbury, the writer, and 9 assistants, at "Lavorika," Ulster County, New York (2000 ft. altitude); (C) Rev. C. R. Gregory, Merrifield, New York; (D) J. C. Swanson and Phy-Chem Club, near Durham, North Carolina; (E) L. D. Hampton, Alabama Poly. Inst., Auburn, Alabama. The results in this table are for observers counting only.

Hour	A	A′	B	B′	C′	D	E′
12-13	....	....	....	44	[15]	8	....
13-14	(7)	[4]	....	64	61	11	....
14-15	137	68	....	99	81	27	....
15-16	160	80	....	117	[54]*	63	53
16-17	229	114	....	126	....	58	[27]*
17-18	162	81	....	48	....	48	....
18-	15	8	....	....	....	....	....
Total	710	....	(2617)	....	211	215	80

NOTE. Where the letter is primed, it shows that the results are reduced to one observer as a unit. Where a number is square-bracketed, it means that the time was less than an hour; if * is added, the time was exactly half an hour. The (2617) under B include duplicates.

It can be seen at a glance that for perfect conditions the rate averaged from one to two meteors per minute. But from B, the station occupied by the writer, the rate for one of the observers, Mrs. Cecil Chichester, counting to the S.E. rose to 180 per hour from 15 to 16 hours, E.S.T., and from the *Patoka* to 4 per minute. A good many Leonid radiants can be deduced from the maps of our A.M.S. members. These will be published later, as they have not yet been fully reduced. Reports received by us, but already published by others, are not here discussed.

As all observers report many brilliant Leonids, and many which left long enduring trains, we may feel that the 1931 Leonid shower fully came up to expectations, and confirms our hopes for a better shower in 1932 or 1933 or both.

Several fireballs, besides those accompanying the Leonids, have been reported recently from this part of the country. Two were seen about 7:50 P.M. and 9:16 P.M. respectively from Philadelphia on November 23. Also a very remarkable one fell at 6:52 A.M., E.S.T., on December 2, just after dawn, over central Virginia. We are very eager to get many observations on this latter, as it had unusual characteristics, among others leaving a smoke train visible for nearly an hour. A note in the Philadelphia papers brought in over a hundred letters about the objects on November 23, as they came early in the evening. A similar note in the Virginia papers, appearing nearly a week late as the writer did not at once learn

of the fireball, has brought in about thirty replies, despite the hour of its appearance, when few people were outdoors.

TABLE I.

Observer and Station	1931 Nov.	Began	Ended	Total Min.	Meteors	Fac.	Remarks
Staff at U.S. Naval Observatory, Washington, D.C., communicated by Capt. J. F. Hellweg, Superintendent.							
Bestul, S. M.	16	15:00	17:15	135	31	0.4	Cloudy at end;
Burton, H. E.	16	14:40	17:05	145	29	0.4	All Leonids.
Browne, W. M.	13	12:00	15:00	180	20	0.5	2 ob. facing dif. quadrants. Only 1 Leonid.
Scott, F. P.	13	15:00	15:45	45	1		Not a Leonid; Stopped by clouds.
Nordberg, J. J.	16	12:00	12:50	50	4	0.4	3 Leonids.
	16	12:50	13:30	40	7		5 Leonids. Two observers.
	16	13:30	14:00	30	7	0.4	3 Leonids.
	16	14:00	15:00	60	15	0.4	13 Leonids. 2 observers. Most Leonids bright as Sirius.
Willis, J. E.	14	12:25	15:30	185	9	0.5	1 Leonid. 2 observers facing dif. directions.
Hampton, L. D., Auburn, Alabama	8	14:45	15:30	45	5	1.0	3 Leonids.
	13	14:30	15:30	60	12	1.0	3 Leonids.
	14	15:15	16:15	60	15	0.9	7 Leonids.
	16	15:00	16:30	90	80	1.0	77 Leonids. Did not count if train or flash only was seen.
Haskell, M., West Los Angeles, Calif.	15	16:00	?	15	26		
Thompson, C. W., Los Angeles, Calif.	16	13:45	14:15	30	29	0.9	Less than 10 not Leonids.
Baily, J. L., Jr., San Diego, Calif.	15	12:00	15:00	180	26		
Steedman, G. F., Santa Barbara, Calif.	16	16:40	17:40	60	40±		
Larrabee, Miss L. M., Honolulu, T. H.	16	13:47	16:17	150	36	0.7	Cloudy at end. ? observers.
	17	14:55	15:55	60	35		Restricted view. 4 observers.
Wheeler, Miss C., Hutchinson, Kansas	14	12:30	15:30	180	58		
	15	12:30	15:30	180	34	0.8	
	17	13:00	14:00	60	15		
Wakefield, E. M., Glasgow, Kentucky	15	12:00	16:00	240	32	1.0	Partial count; bright meteors only. "Many other small ones" seen.
Mackiernan, D. S., Stoughton, Massachusetts	10	10:15	14:00	225	26		All plotted.
	11	10:30	14:00	210	61		All plotted.
	13	10:15	15:25	310	100		All plotted.
Gushee, Miss V. M., Ludlow, Massachusetts	13	13:00	14:00	60	45		All Leonid; five obs., 4 different directions.
	13	14:00	14:50	50	7		
	13	13:25	13:47	22	9		

	1931 Nov.	Began	Ended	Total Min.	Meteors	Fac.	Remarks
Lustman, Miss L. R., and Ebbighausen, E., Minneapolis, Minnesota	15	13:30	18:00	270	12	0.7	Leonids; all plotted. In city.
Fauntain, C. G., Evans Mills, New York	16	16:45	?	?	60	1.0	
Fauntain, Mrs. C. G.	16	12:00	13:30	90	6	1.0	Obs. from window.
Gregory, C. R.,	13	14:30	16:00	90	23	0.9	9 Leonids.
Merrifield, New York	16	12:35	13:00	25	15	0.9	Intermittent observations, eastern sky. 8 Lnds.
	16	13:00	15:30	150	196	0.9	Eastern sky; 157 Leonids.
Phy-Chem Club, Durham	14	12:00	16:00	240	9	1.0	At least 2 obs.
H. S.,Durham, N. C.,	15	13:00	15:50	?	5	0.8	
Swanson, J. C.,Advisor	16	12:00	18:00	360	215	1.0	At least 2 obs. Max. from 15:30 to 16:00.
Lewis, T., Guilford College, North Carolina	16	13:00	14:00	60	23	0.6	
Windsor, R.,	15	11:07	12:00	53	1	0.8	Partial count?
Dayton, Ohio	17	13:08	13:50	42	7	0.7	Partial count?
	15	13:00	15:00	120	8	1.0	Partial count, Hillsboro, O.
Rosengarten, Dr. G., Brookline, Pennsylvania	13	14:30	15:40	70	15	0.9	
Barnard Astronomical Club, Nashville, Tennessee, Shearon, W. H., Secretary	14	11:00	15:00	300	74		Group of observers. Only those "clearly seen" counted.
Hogan, P. J., Laredo, Texas	14	15:30	16:15	45	10		6 Leonids; all faint.
	17	14:25	16:00	95	43		35 Leonids; 2 observers.
Stelzenmuller, Wm., Fairhope, Alabama	16	15:30	17:30	?	50	0.7	
Robeson, C. L.,	16	9:	10:30	90	82		
Tampa, Florida	16	16:45	18:00	75	[200±]		"one every 20 or 25 seconds"
	17	9:	10:30		[40±]		"diminished al-
	17	16:45	18:00		[100±]		most half in no.
	18	"Same hours"			12±		
	19	9:15	10:00		2		
Dimick, Miss L. M., Honolulu, T. H.	16	13:45	15:45	120	43	0.7	Sky area limited.
Allen, J. S., Colgate Univ., Hamilton, New York	16	12:00	13:00	60	30	0.9	24 Leonids.

TABLE II.

MRS. HELEN M. EDWARDS, FAIRHOPE, ALABAMA.

1931 Nov.	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
14	12:00	14:30	150	23	0.7	9.2	13.1	Count

A. M. BRAYTON, PASADENA, CALIFORNIA.

Nov.	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
15	11:40	15:30	230	23	0.7?	6.0	8.6	22 plotted; 14 Leonids.
16	11:40	13:57	137	75	0.7?	32.9	47.0	6 plotted; 64 Leonids.
17	11:40	16:17	277	27	0.7?	5.9	8.4	17 plotted; 16 Leonids.

M. R. Ensign, Gainesville, Florida.

Nov.	Began	Ended	Total	Meteors	F.	Rate	Cor.Rate	Remarks
16	16:00	16:30	30	48	0.9	96	106.7	
16	16:30	17:00	30	75	0.9	150	166.7	2 obs. for last 15 min., facing different directions.
16	17:00	18:00	60	281	0.9	140.5	156.1	2 obs. facing different directions.
17	17:10	17:30	20	12	1.0	36.0	36.0	11 Leonids, faint; by W. A. Merrill.

T. H. Bockhoff, 25° 15′ N., 79° 55′ W.

16	16:00	17:00	60	11	1.0	11.0	11.0	Plotted. Were not others seen?

Edwin P. Martz, Jr., Oak Park, Illinois.

14	15:50	18:00	130	7	0.5	3.2	....	5 plotted. In city.

W. J. Persons, Kalamazoo, Michigan.

16	16:25	16:55	30	80	0.5	160.0	?	24 observers, but no duplication in count.**
17	17:40	18:25	45	29	...	38.6	....	

**With Prof. John Fox and 22 students of Western State Teachers College.

James H. Logan, New York City.

13	14:55	16:25	90	14	1.0	9.2	9.2	9 plotted; 2 observers.

Kenneth E. Gell, Rochester, New York.

16	13:30	18:30	300	710	0.9	71.0	78.9	2 obs., 1 to N., 1 to S.

James E. McKee, Bellville, Ohio.

15	15:00	16:15	75	8	0.9	6.4	7.1	Plotted.
16	14:29	15:59	90	21	0.9	13.9	15.4	Plotted.

Lincoln La Paz, Westerville, Ohio.

14	14:00	15:00	60	6	0.8	6.0	7.5	All plotted.
16	15:00	17:30	100	38*	0.4	22.8	...	All plotted; 1 asst.
16	17:30	18:17	37	25*	0.4	40.6	...	All plotted; 2 assts.
18	17:30	18:15	45	11	0.8	14.6	18.4	All plotted.

*All 2nd magnitude or brighter.

Stewart R. Baker, Collegeville, Pennsylvania.

13	12:15	13:45	90	49	0.9	32.7	...	4 observers.

Franklin W. Smith, Glenolden, Pennsylvania.

4	8:00	9:00	60	3	0.9	3.0	3.3	Plotted.
6	7:20	9:08	83	5	0.9	3.6	4.0	
13	15:50	17:30	100	15	0.9	9.0	10.0	Plotted.

W. P. Wamer, Upper Darby, Pennsylvania.

13	13:27	14:05	38	4	0.7	6.3	9.0	
13	17:07	17:22	15	0	0.8	0.0	...	By S. G. Barton.

William F. Scudder, Wellsboro, Pennsylvania.

16	14:12	15:12	60	52	0.7	...	...	Six bright.

Stuart O'Byrne, Webster Groves, Missouri.

14	12:10	13:00	50	12	1.0	14.4	14.4	Two Leonids.
14	13:09	14:09	60	28	1.0	28.0	28.0	Seven Leonids.
14	17:07	17:40	33	9	0.8	16.4	20.5	8 Leonids; by Miss O. Schregardus.
15	11:49	12:49	60	10	1.0	10.0	10.0	

Alpha Nu Fraternity, Denver, Colorado.

15	15:00	17:00	120	21	1.0	...	...	Six observers.
16	15:00	16:00	60	92	0.8	...	...	Ten observers.

Alpha Nu Fraternity, Boulder, Colorado.

15	14:00	17:00	180	(149)	1.0	11.7	11.7	Six observers.
16	14:00	17:00	180	(697)	0.8	43.3	54.3	Eleven observers.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1931 December 17.

The 1931 Leonid Meteors

A preliminary report of the 1931 Leonid meteors was published in the December issue of POPULAR ASTRONOMY, and an additional report follows. The most nearly complete counts near the date of maximum were made at Dubuque, Iowa, under the direction of Father John A. Theobald of Columbia College, and his report is published separately. The Dubuque counts are especially valuable on the night of the seventeenth when conditions in Iowa City were poor, and the results therefore somewhat uncertain.

Additional reports from other sections have been received by letter or in publications since the preliminary summary was mailed to the editors. Dr. Paul W. Merrill of the Mt. Wilson Observatory writes that from the ground at Las Vegas, Nevada, in an interval of 20 minutes, 40 Leonids were seen under good, but not perfect, conditions. This is at the rate of two per minute for one observer, the same as at Iowa City last year. Professor Hampton, at Auburn, Alabama, counted 53 per hour, but he was watching from a station with limited view. Professor Beck at Tucson, Arizona, saw 70 per hour. The highest rate was reported by Professor Olivier, watching from a station in the Catskill Mountains, 90 being observed in the one-half hour from 15:30 to 16:00. This is at the rate of three per minute and shows that under the best conditions the display was quite spectacular.

An interesting observation was reported to *Science Service* by A. M. Skellett, of the Bell Telephone Laboratories at Deal, New Jersey. He observed a "very erratic and disturbed condition of the Heaviside layer" on November 16. This was not of the type produced by magnetic storms and Mr. Skellett attributed it to the swarm of meteors raining down from the sky. The disturbance to the Heaviside layer resulted in a fogging of radio signals.

The times are 90th meridian and noon-to-noon reckoning.

Date	Obs.	Beginning	Ending	Minutes	Meteors	Leonids	Rate	Remarks
Nov. 8	Ht	14:45	15:30	45	5	3	7	1
12	Fry	14:00	15:00	60	2	.	.	6
12	Kl	14:04	14:34	30	1	.	2	9
12	Wy	15:10	15:40	30	9	2	18	9
13	Ht	14:30	15:30	60	12	3	12	1
14	Ht	15:15	16:15	60	15	7	15	1
15	Bf	11:00	11:30	30	3	.	6	2
		11:30	12:00	30	11	.	22	2
		12:00	12:30	30	7	.	14	2
		12:30	13:00	30	5	.	10	2
		13:00	13:30	30	10	.	20	2
		13:30	14:00	30	15	.	30	2
		14:00	14:30	30	6	.	12	2
		14:30	15:00	30	11	.	22	2
		15:00	15:15	15	5	.	20	2
15	Hf	15:15	15:30	15	14	.	.	3
		15:30	15:45	15	23	.	.	3
		15:45	16:00	15	16	.	.	3
		16:00	16:15	15	20	.	.	3
		16:15	16:30	15	17	.	.	3
		16:30	16:45	15	20	.	.	3
		16:45	17:00	15	24	.	.	3
15	F. J.	15:57	17:30	93	46	.	.	4
16	Hf	14:05	14:15	10	11	.	.	3
16	Ht	15:00	16:30	90	80	77	53	1
17	Bd	12:00	13:00	60	15	7	15	5
		13:00	14:00	60	18	7	18	5

Date	Obs.	Beginning	Ending	Minutes	Meteors	Leonids	Rate	Remarks
Nov. 17	Mc	13:30	14:00	30	16	.	32	5a
17	Bt	15:20	16:00	40	21	.	31	5b
19	Kn	11:00	11:30	30	6	.	12	9
19	T	16:30	17:00	30	2	.	4	6
22	Mn	15:30	17:00	90	28	.	19	10
24	Bd	16:00	16:30	30	0	.	.	7
Dec. 1	Bt	15:45	16:30	45	12	.	16	8

REMARKS.

1.—Limited view, southeastern sky visible to zenith, observations made at Auburn, Alabama.

2.—Observations made from the roof of Tipton High School and Junior College at Tipton, Iowa.

3.—Observations made from the campus of Beloit College, Beloit, Wisconsin. Sky clear on the fifteenth. On the morning of the sixteenth, a watch was maintained for one-half hour during which, for a ten-minute period, the eastern half of the sky was free from clouds, although somewhat thick. The count was made with the entire group facing the east for this ten-minute period on the sixteenth.

4.—Observations were made at St. Paul, Minnesota. The paths of 27 Leonids, and two other bright meteors, were plotted, making the count lower.

5.—Count made at Iowa Citv, Iowa. Watched from station where lights interfered. Poor sky.

5a.—Count made at Iowa City, Iowa. Watched from roof, where lights interfered less than for Mr. Boyd. Poor sky.

5b.—Observations made at Iowa City, Iowa. Watched from golf links away from lights, but half of sky was covered with clouds. This was the only partially clear interval after 14:00 at Iowa City, Iowa. Conditions were better at Dubuque, Iowa. See report of Father J. A. Theobald.

6.—Observed from Iowa City, Iowa. Some interference from ornamental street lights.

7.—Observations made at Iowa City, Iowa. Patchy clouds, ornamental street lights and full moon interfered, but observer believes he would have seen any really bright Leonids.

8.—Observed from outskirts of Iowa City, Iowa. Sky clear, watched toward west away from moon, which was at last quarter.

9.—Observed from outskirts of Iowa City, Iowa, away from lighted district.

10.—Observed from country near Iowa City, Iowa.

OBSERVERS.

Bf—Miss Ruth A. Balluff, graduate University of Iowa, instructor in Tipton Junior College.
Bt—Mr. Charles F. Bartlett, a student at the University of Iowa.
Bd—Mr. Bemrose Boyd, a student at the University of Iowa.
Fry—Miss Margery L. Fry, a student at the University of Iowa.
F. J.—Mr. Thomas Flood and Mr. Joseph Janning, formerly students at Columbia College, Dubuque, Iowa.
Ht—Professor L. D. Hampton of Alabama Polytechnic, Auburn, Alabama.
Hf—Professor R. C. Huffer and students of Beloit College, Beloit, Wisconsin. Ten observers on November 15 and nine on November 16.
Kl—Mr. Irvin F. Keeler, research assistant in astronomy, University of Iowa.
Kn—Mr. Lloyd A. Knowler, a student at the University of Iowa.
Mc—Mr. W. A. McCloy, a student at the University of Iowa.
Mn—Mr. Vincent N. Minette, a student at the University of Iowa.
T—Mr. Emil G. Trott, a student at the University of Iowa.
Wy—Professor C. C. Wylie, University of Iowa.

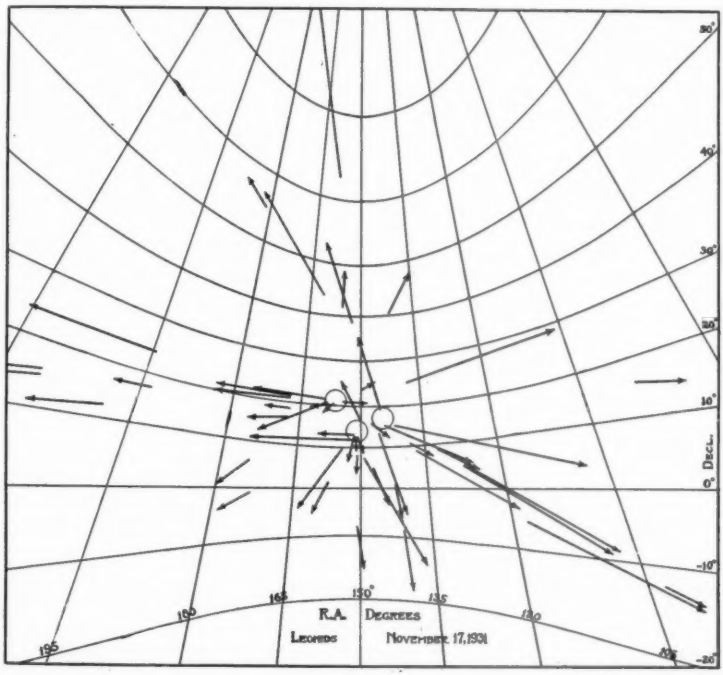
C. C. WYLIE.

University of Iowa, December 19. 1931.

The Leonids—1931

The return of the main body of the Leonids on November 16 and 17, 1931, fortunately occurred under somewhat more favorable weather conditions in Cleveland than at many other stations where plans had been made to observe the meteors.

Observations were made by the writers at the Warner and Swasey Observatory between the hours of 1:30 and 6:00 A.M., Eastern Standard Time, on each of the mornings mentioned. The weather was quite warm with a southerly breeze prevailing on both nights. On November 16 the sky was clear. The following morning, however, the sky became milky; at one time light clouds nearly obscured



the region of observation and most of the stars of the fourth magnitude were not visible to the naked eye. There was no illumination of the sky on account of the moon since the moon's right ascension preceded that of Leo by nearly twelve hours. The region of Leo rose above the horizon about 12:30, E.S.T., but no meteors were observed until an hour later.

Only a little more than the eastern half of the sky was watched continuously. A record of time, place of appearance, and disappearance, estimated magnitude, time of flight, and in some cases color and train, was kept.

During the morning of November 17 a photograph of the Leo region was made with a 3-inch Ross lens and with an exposure of four hours. A hypersensitive panchromatic plate was used. The expression $(2.5)^M = 26(a^3/fv)\,\phi\,(S, C)$,

given in *H.C.B.* 872, gives +0.5 for the magnitude of the faintest meteor which could have an image on the plate. Two bright meteors recorded within the field of the camera were estimated as zero magnitude. Since no meteor was photographed and since no other criterion for correcting estimated magnitudes is available, a correction of +0.5 magnitude was applied to all estimates.

The hourly rate of the meteors is given in the following table for each morning of observation:

TABLE I.

Date	Classification	Hours E.S.T. 1-2	2-3	3-4	4-5	5-6	Total
Nov. 16	Leonids	0	0	0	2	6	8
	Non-Leonids	3	4	10	4	10	31
Nov. 17	Leonids	3	11	6	12	19	51
	Non-Leonids	7	12	14	8	11	52

It is apparent on both dates that the maximum number of Leonids was observed between the hours of five and six A.M.

Table II gives the distribution of the meteors with respect to magnitude.

TABLE II.

		Magnitude 0	1	2	3	4	Average Magnitude
Nov. 16	Leonids	0	1	2	4	1	2.7
	Non-Leonids	2	3	6	9	11	2.8
Nov. 17	Leonids	1	14	19	14	3	2.0
	Non-Leonids	3	3	14	26	6	2.6

Table III shows the three radiants obtained from the visual plots. All meteors whose projected paths pass by more than 2° from the adopted radiant points were rejected. The effect of the zenith attraction was not included.

TABLE III.

Date	Number of Meteors	Right Ascension	Declination
Nov. 16	8	154°.5	21°.0
Nov. 17	14	144.6	16.0
	17	151.0	13.7
	20	156.8	20.8

During the early part of the period of observation on November 16 there was a distinct tendency for the meteors to emerge from the region of Gemini. Not until the last hour of observation were many Leonids recorded. On November 17, however, in the first hour of recording many more meteors were seen from Ursa Major than elsewhere. Again the Leonids did not appear in great numbers until late in the morning. No distinct radiant point could be derived from either of the non-Leonid groups, the meteors appearing almost at random.

Some bright meteors left long and bright trains. A zero magnitude bluish white meteor at 3:39 A.M., E.S.T., November 16, left a train of about 40° in length which lasted 15 seconds. The point of radiation was about 2° south of Pollux and in the direction of Aldebaran.

J. J. Nassau and Sid McCuskey.

Dubuque Counts of the 1931 Leonids

The program at Columbia College, Dubuque, Iowa, as was stated by C. C. Wylie in the December issue of Popular Astronomy, included counts of the number of meteors seen by a group, of the number seen by a single observer, and

of the number of meteors considered brighter than Jupiter. On the nights of the fourteenth, fifteenth, and sixteenth, groups and single observers worked in relays to cover the hours from midnight to dawn. For a few nights, before and after, the plan was to cover only the period from 15:00 to dawn. The nights of November 13 and November 14 were cloudy. On the night of November 15 conditions were reasonably good and observations were made from midnight to dawn as planned. The night of November 16 was completely cloudy. On November 17 conditions were again good and observations were made from 14:45 to 18:00. Clouds prevented any further observations within the period when Leonid meteors might reasonably be expected. The following is a summary of the results, the times being 90th meridian and noon-to-noon reckoning.

1931	Began	Ended	Min.	Group Count Total	Single Observer Total	Brighter than Jupiter
Nov. 15	12:00	12:15	15	6	4	.
15	12:15	12:30	15	6	2	.
15	12:30	12:45	15	11	8	1
15	12:45	13:00	15	12	8	.
15	13:00	13:15	15	9	7	.
15	13:15	13:30	15	8	2	.
15	13:30	13:45	15	13	7	.
15	13:45	14:00	15	10	7	1
15	14:00	14:15	15	3	2	.
15	14:15	14:30	15	9	7	.
15	14:30	14:45	15	11	8	1
15	14:45	15:00	15	8	5	.
15	15:00	15:15	15	9	5	.
15	15:15	15:30	15	14	7	.
15	15:30	15:45	15	14	7	.
15	15:45	16:00	15	18	7	2
15	16:00	16:15	15	17	7	1
15	16:15	16:30	15	15	3	2
15	16:30	16:45	15	22	5	1
15	16:45	17:00	15	19	7	1
15	17:00	17:15	15	15	4	2
15	17:15	17:30	15	21	4	1
15	17:30	17:45	15	16	3	2
15	17:45	18:00	15	3	1	.
Nov. 17	14:45	15:00	15	.	8	4
17	15:00	15:15	15	21	6	2
17	15:15	15:30	15	22	6	.
17	15:30	15:45	15	17	6	2
17	15:45	16:00	15	16	5	1
17	16:00	16:15	15	14	8	2
17	16:15	16:30	15	20	9	1
17	16:30	16:45	15	16	5	1
17	16:45	17:00	15	23	11	1
17	17:00	17:15	15	26	15	.
17	17:15	17:30	15	22	13	.
17	17:30	17:45	15	13	6	.
17	17:45	18:00	15	4	2	.

SINGLE OBSERVER—

Nov. 15—12:00 to 14:00—Alvin Jaeger
14:00 to 16:00—Louis Ernsdorff
16:00 to 18:00—Gordon Saunders
Nov. 17—14:45 to 15:00—Gordon Saunders
15:00 to 16:00—Melvin Petry
16:00 to 17:00—Louis Ernsdorff
17:00 to 18:00—Alvin Jaeger

GROUPS OBSERVING—

Nov. 15—12:00 to 14:00—Orlin Conlon, Robert Becker, George Martin, Leonard Jaeger, John Martin, Lester Cooling, Rueben Kramer.
14:00 to 16:00—Nicholas Sutton, Lawrence Kelly, Michael Cavanaugh, Thomas Moran, Robert Ernsdorff, Frank Schuetz, Victor Hand.
16:00 to 18:00—Melvin Petry, James McFadden, Francis Kevane, Charles Seda, Francis Kernan, Edward Urness, John Kleiner.
Nov. 17—15:00 to 16:00—Gordon Saunders, James McFadden, Francis Kernan, Francis Kevane.
16:00 to 17:00—Nicholas Sutton, Lawrence Kelly, Michael Cavanaugh, Thomas Moran, Frank Schuetz, Robert Ernsdorff.
17:00 to 18:00—Orlin Conlon, John Martin, George Martin, Robert Becker, Leonard Jaeger, Rueben Kramer.

Reports received from Thomas Flood and Joseph Janning (formerly students at Columbia College) have been forwarded to the University of Iowa for discussion with other reports on this shower.

JOHN A. THEOBALD.

Columbia College, Dubuque, Iowa, December 18, 1931.

Comet Notes

By G. VAN BIESBROECK

Unless some unexpected comet is found between now and the end of the year, 1931 will go on record as rather uneventful as far as cometary apparitions are concerned.

Two periodic comets were found not far from the place where they were expected: 1931 *a* (ENCKE) and 1931 *d* (NEUJMIN). Another one WOLF (2) will apparently go by unobserved on account of its faintness and the uncertainty of its exact location. Aside from these, two new objects were added to the cometary records 1931 *b* (NAGATA) and 1931 *c* (RYVES). Both were found by amateur astronomers but both remained all the time under unfavorable conditions of observation.

The last observation of NAGATA'S COMET (1931 *b*) secured here was on November 28. During December the Sun passed between the earth and the comet so that the latter has now become a morning object. When last seen here it appeared as a round coma some 20″ in diameter; the brightness was recorded as 13^M but this figure is quite uncertain on account of the low altitude of the object which was then only ten days from conjunction with the Sun. It is not improbable that further observations will be secured in January although the continued decrease in brightness may place the object beyond the limit of observation at that time.

COMET 1931 *c* (RYVES) was no longer seen nor found on photographic plates after the date November 18 mentioned last month. It seems to have completely melted away after that date, so that the total length of visibility extends over a hundred days, but with a gap of more than a month during conjunction with the Sun.

Except for its slow decrease in brightness there has not been much change in

the appearance of PERIODIC COMET NEUJMIN (1931 *d*). Yet on some plates taken here the nucleus seems less starlike than on others but this is difficult to establish definitely when it is recalled that the images are near the limit of the power of the telescope. On the last record obtained here, December 16, the brightness was about $17\frac{1}{2}^{M}$ and it is doubtful if further observations will be made here nor elsewhere.

On December 12 the expected PERIODIC COMET SCHWASSMAN-WACHMANN (1925 II) was observed by the writer, very close to the ephemeris position given last month (p. 613). The prediction requires the small correction

$$(O.-C.) : \quad -0^{m}3 \text{ and } +2'.$$

The comet which was photographed again on December 15 and 16 was about as bright as a 16^{M} star but it already showed indications of change in aspect: very small and nearly starlike on December 12, three days later it had expanded to a diffuse round coma about 20″ in diameter with little indication of any nucleus. On plates taken November 18 and December 8 no trace of the comet could be found although stars as faint as 17^{M} are well visible on them. It will be well worth while to continue the watch on this object.

According to the *Handbook for 1932 of the British Astronomical Association* no less than nine periodic comets will come nearest to the Sun during the new year. Elements and Ephemerides for each are given in that valuable publication. The following data are of interest:

PERIODIC COMETS EXPECTED IN 1932.

Name.	Period in years.	Perihelion date 1932.	Visibility.
1. Schorr 1918 III	6.60	Jan. 6	Evening in winter.
2. Grigg-Skjellerup	5.02	May 8	Evening in spring.
3. Neujmin (2)	5.43	June 19	Evening in spring.
4. Wolf (2)	7.53	July 14	Evening in winter.
5. Kopff	6.55	Aug. 20	Summer.
6. Borrelly	6.90	Aug. 26	Summer.
7. Brooks (2)	6.93	Oct. 7	Morning in early summer, evening in fall.
8. Tempel 1866 I	33.36	Nov. 2	Morning in fall.
9. Faye	7.32	Dec. 6	Fall.

Most of these objects will remain quite faint. Nos. 2, 3, 5, 6, 7, and 9 were observed at their last return so that the prediction is quite safe. Of special interest is TEMPEL'S COMET which is responsible for the November meteors or Leonids. Here the uncertainty of the time of perihelion is much larger and this may require considerable sweeping.

More detailed information will be given about these various comets when their respective periods of visibility approach.

Williams Bay, Wisconsin, December 23, 1931.

Notes from Amateurs

Gravity on the Planets

No doubt many interested in science have frequently read comparisons of the weight of a man on the different planets with respect to his weight here on the earth. Recently an article containing this comparison was published in one of the

current periodicals. The figures would be amusing were they not likely to mislead those who are unfamiliar with the subject.

It is the purpose of this article to give a clear conception of the factors governing these weights, and to offer an elementary mathematical method of obtaining fairly accurate results.

Newton proved that the attraction of a sphere for a body upon its surface is the same as it would be were all the matter of that sphere concentrated at one point—the center. Then from this he proved that:

1. The attraction (gravity) varies directly as the quantity of matter (mass).
2. The attraction (gravity) varies inversely as the square of the distance.

From this it is quite evident that the weight depends upon two factors, viz., the quantity of matter (mass) and the size of the planet (distance from the center).

The rotation of a planet on its axis produces a certain amount of centrifugal force, which tends to oppose the attraction. That is to make it less than it would be, did the planet not revolve. Disturbing forces of this kind are usually not very large, except in the case of Jupiter and the other large planets which revolve at a terrific angular velocity. Upon Jupiter, at the equator, this diminution is approximately 1/12. At the earth's equator it is about 1/289. This loss of a man's weight is mentioned not as the chief point, for we may consider him to be at the north or south pole—where the centrifugal force is zero. Yet for more accuracy of a man's weight at the equator, this can be deducted from our final answer.

From Newton's laws:

1. "Gravity varies directly as the mass." If two spheres are of the same size, and one has twice the mass of the other, then gravity will be twice as great, and a body on its surface will weigh twice as much as on the other. If the mass be 3, 4, or more times as great, then the weight will be 3, 4, or more times the other's weight.
2. "Gravity varies inversely as the squares of the distance." Now let the mass of a sphere remain constant, but the size vary. Then, if the diameter of 1 be increased to 2, the weight on its surface would be $(\frac{1}{2})^2$ or $\frac{1}{4}$ what it was previously. If the diameter be increased 3, 4, or more times, the weight would be 1/9, 1/16, or a smaller fraction of its first value.

These two laws contain "all the law" of the subject. Still the prophets sometimes go wild in attempting to apply them.

The following is the application of these laws regarding the weight of a 150 pound man removed to the planets Jupiter and Mars, respectively. It should be understood that these figures are approximate only, the chief point being the method.

1. Jupiter's mass is 310 times the mass of the earth.
2. Jupiter's diameter is 11 times the diameter of the earth.

By (1) 310×150 lbs. $= 46{,}000$ lbs. This would be the weight of a 150 lb. man were the mass of the earth the same as the mass of Jupiter—but its diameter is 11 times that of the earth; therefore—

By (2) $(1/11)^2 \times 46{,}000$ lbs. $= 380$ lbs. answer.

1. Mars' mass is 1/9 the mass of the earth.
2. Mars' diameter is 1/2 the diameter of the earth.

By (1) $1/9 \times 150$ lbs. $= 17$ lbs. This would be the weight of a 150 lb. man were the mass of the earth the same as the mass of Mars—but its diameter is 1/2 that of the earth; therefore—

By (2) $(2/1)^2 \times 17 = 68$ lbs. answer.

Many forms of this method may be used, yet by elementary mathematics the

question is solved. The degrees of accuracy depend largely upon the correctness of the ratio of mass and diameter with respect to the earth.

The importance of applying these two laws jointly cannot be over-stressed. Many ridiculous answers are obtained by the use of one only. This was found to be the case of the previously referred to "amusing figures."

JOHN M. CROTHERS.

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Photography with a Three-inch Telescope.

Early last summer the manufacturer of our 3-inch refractor very kindly offered me the use of a Leitz camera for a few months of experimentation in celestial photography. It seemed unlikely that much could be accomplished with such a small telescope. After considerable experimenting, however, some rather gratifying results were obtained.

THE MOON ON OCTOBER 19, 1931, AT 9:00 P.M., P.S.T.

This camera may be attached to a regular eyepiece by simply unscrewing the flanged cap from the latter and screwing the camera on in its place. The eyepiece may then be placed in the telescope in the usual way. A magnified image may thus be projected by means of the eyepiece (and a small lens in the camera) upon the ground glass or the photographic film. In this way a much larger image may be produced than at the primary focus of the instrument. A considerably longer exposure is necessary, however.

This arrangement allows one to regulate the size of the image by using various eyepieces. It was found that the 31x was about the highest power that would give an image of the entire sun or moon on the film. An image three inches in diameter may thus be obtained.

Some difficulty was encountered at first in focusing the image of the moon sharply on the ground glass. This was overcome by applying a very thin coating of oil on the frosted side, turning out the eyepiece prism (mentioned later) and using a short focus hand lens for viewing the image. By this method, even rather small craters will become quite distinct.

The camera is provided with a guiding eyepiece, set at right angles to the axis of the telescope. Part of the light from the object (seemingly about 50%) is reflected, by means of a prism into this eyepiece. With a bright object like the moon, it is quite easy to set the cross line on a certain point and hold it there providing the driving gear is suitable.

The motion in right ascension was at first attempted by twisting the regular driving handle. Reports indicate that this method has been used quite successfully even for long exposures. It soon became evident that guiding would be more accurate and much easier if the hand of the operator could move faster and more naturally. A few devices were tried and discarded before the one described below was finally used.

The works from the striking side of an 8-day clock were mounted at a convenient height on a stand. The various levers were removed so that a free system of gears was obtained. The key post was connected to the worm gear post of the telescope by means of a small rod and a universal joint. A large spool, provided with a turning handle, was mounted vertically on another stand. This could be set anywhere on the observatory floor within easy reach from the eyepiece of the camera. The spool was connected to the clock gears by means of a string belt. This belt ran over the spindle of the "last but one" wheel. The surfaces over which the belt ran were taped so that no slipping would occur.

With this arrangement a fairly rapid motion of the turning handle was required to give the slow motion needed by the rod connecting with the telescope. This was about one-half turn per second. With a little practice it was possible to hold an image on the cross line of the eyepiece quite accurately during an exposure.

It was soon decided that where well-defined detail was wanted (as on the moon), the shortest exposures would result in the least errors in guiding. Superspeed films helped greatly. Since a large part of the light entering the telescope was diverted to the guiding eyepiece, a plan was worked out by which all the light would go to the film. This was accomplished by throwing the prism out of the path of light. With no image left to follow, an arrangement was fixed so that guiding could be done "by ear."

The works from the "time" side of the clock were mounted and a long pendulum carefully adjusted in length until it would tick once during each one-half turn of the handle while the latter was going at the speed needed to keep the cross line of the eyepiece on the object being followed. After the regulation was satisfactory, the prism was pushed aside and the eyepiece was not in use. The centering of the image on the film at the beginning of the exposure was then estimated by the view obtained through the regular finder of the telescope.

The ticking of the clock works makes it very easy to turn the crank on the spool quite evenly. It is a great help in obtaining fairly uniform motion even on

long time exposures, although visual means must be employed at the same time if accurate guiding is to be obtained. However, for lunar photography it has been found to work quite well. When the moon is near the "quarter" phases, 10 to 15 seconds of exposure have been found to give the best results.

I want to express my appreciation for the help given with the camera by Michael G. Bugarr, one of my students; for the developing and printing by the Carl Baker Film Shop. I am especially indebted to Wm. Mogey & Sons, Inc., for their kindness in allowing me the use of the astronomical camera.

Eugene, Oregon. J. Hugh Pruett.

Zodiacal Light Notes

By W. E. GLANVILLE

New Zealand Reports. Covering observations between March 27 and September 29, 1931, Mr. M. Geddes, director of the Aurorae and Zodiacal Light Section, has sent reports of coöperating members. Messrs. D. Wilkinson, C. Richardson, F. J. Morshead, R. A. McIntosh, and M. Geddes made 36 observations. Mr. Geddes also made nine observations of the Gegenschein. Mr. Richardson's observations were made at King Island, Tasmania, the rest were made in New Zealand; the range of latitude extended from 37° S. to 46° S. On March 27, April 23, 29, and May 29, Mr. McIntosh observed the Morning Zodiacal Light. On April 23 he found the apex at Theta Capricorni. On the southern side the boundary was indicated by Delta Aquarii thence to one degree north of Beta Ceti. On the northern side it extended from Zeta Aquarii northeast. On May 29, the south limit of the base was one degree north of Gamma Ceti, the north limit was Iota Arietis, the apex was at Sigma Aquarii. "The Light was bright, straight and narrow." Mr. Richardson's observations were made in the evening. On May 18 he reports the Light practically nil. On June 17 he found the Light exceedingly conspicuous and on July 4 it extended almost to the zenith. On July 8 and 9 it was extremely faint and on July 14 it "suggested the reflection of a bush-fire." Mr. Geddes made evening observations on July 10, 15, 17, 31, August 3, 5, 6, 7, 9, 10, 13, 20, 30, September 10, 11, 12, 28, 29. On July 15 he found the apex at Upsilon Leonis; the north boundary was marked by Sigma Leonis, the south by Iota Hydrae. The north boundary was sharply defined, the Light quite bright. On July 17 the sky was generally hazy but "the Light was much brighter than previously." On August 2 the apex was slightly north of Spica. The north boundary was marked by Theta Virginis, the south by Iota Hydrae. The north edge was clearly defined, the south edge diffuse. "The brightest part of the Light was almost equal to the galaxy in Aquila." On August 9 at 10:00 P.M. he found the apex of the Light close to the western horizon and very faint. On August 30 the apex was just south of Iota Librae. The north boundary was marked by Alpha Librae and Xi Virginis, the south boundary by Delta and Gamma Corvi. "Brightness of inner cone was equal to twice that of the galaxy in Scorpio." On September 10 he found the Light very faint in a clear sky. The north boundary passed through Alpha Librae and Xi Virginis; the south boundary through Eta Corvi. On September 29 the apex was lost in the galaxy in Scorpio; the north boundary passed through Beta Scorpionis, the south boundary through Sigma Scorpionis; the brightness was equal to the galaxy in Scorpio and "the north boundary showed

much better definition than did the south boundary." On August 7 at 6:45 P.M. Mr. Geddes found the Light steady and distinct with clear-cut north edge. At 7:45 in company with Mr. Morshead the whole body of the Light had undergone fluctuations and the north edge was very hazy.

By plotting the data it is seen that from New Zealand and Tasmania the main body of the Light is found south of the ecliptic; it is also seen that the north boundary (apart from the condition of general fluctuation) is sharply defined. In the north temperate latitudes the reverse is true in both respects. It is also noted that when the morning Light is well placed for observation the evening Light is scarcely, if at all, visible. Why in the southern hemisphere the north boundary of the Light is clear-cut while in the north hemisphere the south boundary is sharply defined, is a question that deserves consideration. The Gegenschein observations were made by Mr. Geddes on August 6, 7, 9, 13, 14, 21, September 11, 16, 18. On August 21 he found the major axis along the ecliptic 14°, the minor axis 7°, the shape was that of an ellipse; on September 16, the major axis was estimated at 15°; minor axis, 14°7. On August 9, 13, 14 the object was so faint that boundaries could not be determined. Time of observations ranged from 11:00 P.M. to 2:00 A.M. The members of the Zodiacal Light Section of the New Zealand Astronomical Society are worthy of congratulations on the foregoing reports.

During the past month fog and densely cloudy weather interfered considerably on moonless nights at this station. The writer made evening observations on November 30, December 2, 5, 7, and morning observations on December 7 and 8.

Evening Zodiacal Light. From 7:25 to 7:45 P.M., November 30, Alpha and Beta Capricorni were well within the north boundary and Delta and Gamma Capricorni were on the edge of the south boundary. Very faint extension was traced through Pisces and Aries to Taurus. (Compare with Mr. McIntosh's morning observation of April 23.) On December 2 from 7:15 to 7:25 the general appearance was quite diffuse. Saturn was near the south boundary. At 9:00 P.M. the Light was still visible but extremely faint. The Square of Pegasus now showed just above the broader part of the Light. Average breadth west of the meridian was about 7°; east of the meridian it had the appearance of a band, on to the galaxy, about 3° in breadth. On December 5 at 8:30 P.M. the boundaries passed on the north through Beta Aquarii and on the south through Delta and Gamma Capricorni. On December 7 at 7:30 P.M. the broadly, diffuse appearance of the Light in the west was again noted. When the Light makes a relatively high angle with the horizon it assumes a more columnar shape.

Morning Zodiacal Light. On December 7 from 4:15 to 4:45 A.M. Spica was seen on the south boundary, thence towards Arcturus for two-thirds the apparent distance the north boundary was noted. Eta, Gamma, and Delta Virginis were covered. At Regulus the western limit of the Light was marked, Jupiter in the Sickle of Leo blanketing any further extension. As time for moonrise approached at 4:45 the area next to the horizon brightened considerably. On December 8 from 4:00 to 4:15 A.M. the Light was clear but faint and could be traced to Regulus. From 5:15 to 5:45, Alpha and Beta Librae were both covered, Alpha Librae being very near the south boundary. The Light was generally much brighter than at 4:00 A.M. From Spica across towards Arcturus the Light was narrowed by one-half as compared with apparent breadth at 4:00 A.M. The Light presented an impressive arched appearance as it bent towards Regulus. At 5:45 as dawn came on the western fainter part of the Light faded out and the part from Spica to

the horizon increased in brightness until it was merged with the daylight.

No observations of the Gegenschein were possible on account of its crossing the Milky Way during this month. In January it may be observed in Gemini and Cancer. Also in January the evening Zodiacal Light will well reward the attention of observers.

The Rectory, New Market, Maryland.

General Notes

Professor M. J. Lagrula has been named director of the Observatory at Algiers as successor to Professor M. F. Gonnessiat who has retired from active work.

Dr. Annie J. Cannon, curator of the Harvard College Observatory photographs, has been awarded the Draper Medal of the National Academy of Sciences for her work on the classification of stars by means of their photographic spectra.

Professor D. Eginitis last year concluded his fortieth year as director of the Observatory of Athens. The event was recognized by the Academy of Athens and an appropriate celebration was held last January, at which the president of the republic and other dignitaries were present.

Mrs. Hazel Burton Carpenter, wife of Dr. Edwin F. Carpenter, died at a hospital in Tucson, Arizona, on December 6, 1931. Mrs. Carpenter was well-known in astronomical circles. She graduated from Mt. Holyoke in 1924 with distinction in astronomy; she was an assistant in spectroscopy at the Lick Observatory in 1924-25; and was an instructor in astronomy in Mt. Holyoke from 1924 to 1927. She was a member of Phi Beta Kappa, the American Astronomical Society, and the American Association of Variable Star Observers.

The Rittenhouse Astronomical Society, of Philadelphia, has elected officers for the year 1932 as follows: President, H. B. Rumrill; Vice-president, James Stokley; Secretary, A. Clyde Schock. Plans are being laid for a celebration of the two-hundredth anniversary of the birth of David Rittenhouse, the founder of the society, next April.

Brilliant Meteor Seen in Virginia.—*The Union Star,* Brookneal, Virginia, of December 4, 1931, contains an account of a very bright meteor which was seen early on Wednesday, December 2. It is reported as being as large as the moon and as bursting into two parts. The smoke cloud resulting from it is said to have remained visible for thirty minutes. About two minutes after the explosion a rumbling sound somewhat like a peal of distant thunder was heard.

The Sixty-Nine-inch Reflector Installed.—A letter from Professor Harlan T. Stetson, Director of the Perkins Observatory, Ohio Wesleyan University, states that the large 69-inch mirror has been removed from the optical shops of J. W. Fecker in Pittsburgh and was installed in the Perkins Observatory on December 14. Transportation was affected with the greatest care and every precaution was taken in transferring the mirror from the packing case to the telescope. The installation was completed without a slip or accident of any kind, and brings to

completion the third largest telescope in the world after five years of continuous labor. The finished mirror weights 3000 pounds and has a replacement value of $50,000.

IN MEMORIAM

Professor Solon I. Bailey

He lived his life among the stars,
Yet kept his feet in touch with earth,
And he could do that thing, you see
Achieved alone by men of worth.

Offspring of star dust, if you will,
Like other sons, heaven's refugee;
But star dust that could think and know
From whence and how he came to be.

And so was more than star dust's bloom:—
For, ferreted by star light rays,
He answered back with reason's flame,
And so could know them and their ways.

Thus Heraclitus would affirm,
Democritus would say 'tis so,
For knowledge is the prize of those
Who are akin to what they'd know.

But more,—he knew himself akin
To vaster Mind, the Master Mind
And all the offspring of that Power,
His fellows of another kind.

To erring men "The Just Man" he,
Magnanimous to their vain strife,
An artist who saw beauty deep
In nature and in human life.

Serene as seemed the stars he loved,
He trusted Mind in men and higher
Was counsellor to those who feared,
Breast forward met each peril dire.

The Friend of earth in all her moods,
This finer Friend of Man departs,
The loyalist of his espoused,
He lives immortal in their hearts.

—Spenser B. Meeser.